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SOIL SURVEY

Carroll County Indiana

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

How to use THE SOIL SURVEY REPORT

THIS SURVEY of Carroll County will help you plan the kind of farming that will protect your soils and provide good yields. It describes the soils; shows their location on a map; and tells what they will do under different kinds of management.

Find Your Farm on the Map

In using this survey, you start with the soil map, which consists of the 14 sheets bound in the back of this report. These sheets if laid together, make a large soil map of the county. Roads, rivers, and many other landmarks are on this map.

To find your farm on the large map, you use the index to map sheets. This is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located.

When you have found the map sheet for your farm, you will notice that boundaries of the soils have been outlined in black and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map.

Suppose you have found on your farm an area marked with the symbol Oe. You learn the name of the soil this symbol represents by looking at the map legend. The symbol Oe identifies Ockley silt loam, 0 to 3 percent slopes.

Learn About the Soils on Your Farm

Ockley silt loam, 0 to 3 percent slopes, and all other soils mapped are described in the section Soil Series, Types, and Phases. Soil scientists, as they walked over the fields and through the woodlands, described and mapped the soils; dug holes and examined surface soils and subsoils; measured slopes with a hand level; noted differences in growth of crops, weeds, brush, or trees; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming.

After they mapped and studied the soils, the scientists judged what use and management each soil should have, and then they placed it in a management group. A management group is a group of similiar soils that need and respond to about the same kind of management.

Ockley silt loam, 0 to 3 percent slopes, is in management subgroup 2A. Turn to the section, Nature of the Soils, Suggested Management, and Estimated Yields. This section describes soils having similar characteristics and requiring similar management practices. Under management subgroup 2A in table 6 read what is said about Ockley silt loam, 0 to 3 percent slopes. You will want to study table 7, which tells you how much you can expect to harvest from Ockley silt loam, 0 to 3 percent slopes, under two levels of management.

Make a Farm Plan

For the soils on your farm, compare your yields and farm practices with those given in this report. Look at your fields for signs of runoff and erosion. Then decide whether or not you need to change your methods. The choice, of course, must be yours. This survey will aid you in planning new methods, but it is not a plan of management for your farm or any other farm in the county.

If you find that you need help in farm planning, consult the local representative of the Soil Conservation Service or the county agricultural agent. Members of your State experiment station staff and others familiar with farming in your county will also be glad to help you.

This survey was made to provide a basis for best agricultural use of the land. Fieldwork was completed in 1940, and, unless otherwise specifically indicated, all statements in this report refer to conditions in the county at that time.

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SOIL SURVEY OF CARROLL COUNTY, INDIANA

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

General Nature of the Area

LARGE AREAS of fertile and level land have made agriculture the principal occupation in Carroll County. There are no large cities in the county, and consequently there is very little industry. Corn, soybeans, oats, wheat, rye, alfalfa, and hay are the principal crops. The grain crops, and corn in particular, are used mainly as feed for livestock. Most of the farm income is derived from the sale of livestock and livestock products.

Location and Extent

Carroll County is located in the north-central part of Indiana (fig. 1). The area of the county is approximately 374 square miles, or 239,360 acres. Delphi, the county seat, is 65 miles northwest of Indianapolis, the State capital; 80 miles south of South Bend; 90 miles southwest of Fort Wayne; and 10 miles northeast of Lafayette, the location of the Purdue University Agricultural Experiment Station.

Physiography, Relief, and Drainage

Carroll County lies within the Tipton Till Plain (*6*).[2] This plain occupies most of central Indiana and forms part of the Central Lowland province of the United States (*5*). Since the county is located along the northern limit of this plain, it is bordered on the north by the Northern Moraine and Lake region of Indiana.

Physiography.—The county has three physiographic subdivisions: The uplands or till plain; the terraces; and the bottom lands (figs. 2 and 3).

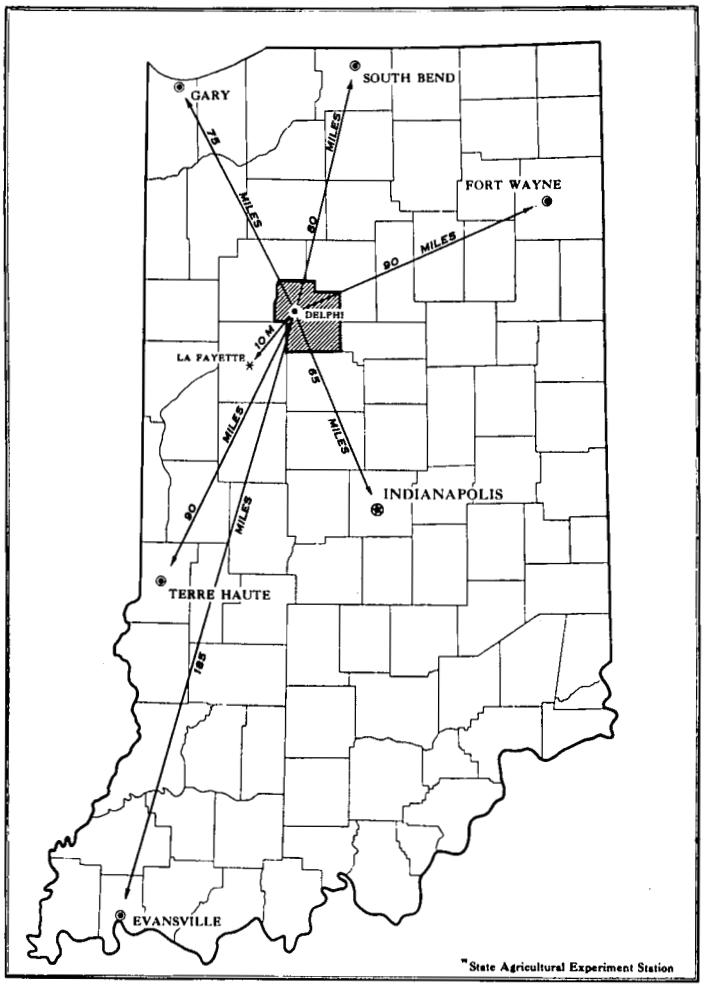


Figure 1.—Location of Carroll County in Indiana.

[1] Fieldwork for this survey was done while Soil Survey was part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

[2] Italic numbers in parentheses refer to Literature Cited, p. 67.

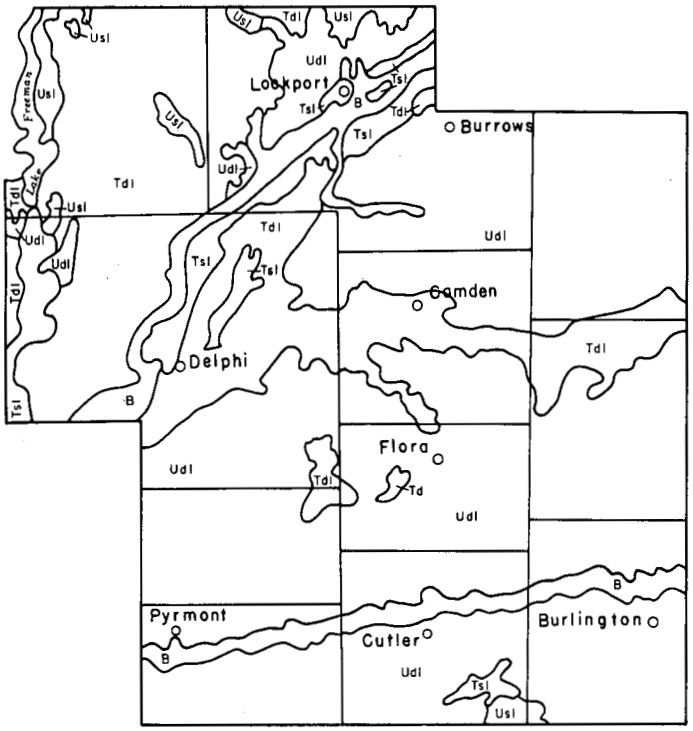


Figure 2.—Physiographic subdivisions of Carroll County, Ind.

1. Upland or till plain:
   (Udl) Deeply leached upland, largely smooth ground moraine.
   (Usl) Shallowly leached upland, largely morainic ridges.
2. Terraces:
   (Tdl) Deeply leached, stratified outwash plains and alluvial materials.
   (Tsl) Shallowly leached alluvial materials.
3. Bottom lands (B).

1. The upland, or till plain, is the most extensive of the three subdivisions. It is nearly level to gently undulating and is representative of a great ground moraine. It is without lakes, but remnants of terminal morainic ridges are present in the northwestern and southeastern parts of the county. Local relief is slight. Destruction of the glacial plain has occurred in only a few places, so it remains much the way it was when the glacier deposited the material. Consequently, drainageways are weakly developed or are lacking. Before drainage systems were installed, drainage was poor and marshes and swamps were common.

2. The terrace subdivision consists of lower stream terraces, higher glacial terraces, and terrace slopes or escarpments. The higher terraces are most extensive in the northwestern part of the county, where they occur as broad outwash plains along the entire valley of the Tippecanoe River. A few terraces of outwash material are scattered over the till plain; they occupy the glacial basins and channels.

3. The bottom lands are relatively narrow and border streams that are entrenched in former glacial valleys.

Relief.—The highest point in the county, 790 feet, is near the southern border. The lowest point, 520 feet, is where the Wabash River leaves the county. The elevation of the till plain ranges from 700 to 750 feet. On the plain, local relief is usually less than 10 feet. A few knolls or ridges rise 30 feet or more above the till plain. The plain has the greatest relief near the northern and southern borders of the county.

The lower terraces have an elevation of about 575 feet, and the higher terraces, about 630 feet. In the valleys of the Wabash and Tippecanoe Rivers, local relief of 100 feet or more is common. The outwash plain along the Tippecanoe River and the basinlike areas on the till plain have an elevation of about 660 feet.

Drainage.—As the ice sheet retreated, glacial streams flowed out, carved broad valleys, and later became deeply entrenched in those valleys. Most of the valleys have not been changed much by the streams now flowing. The main glacial valley of this region carried fairly clear water from glacial lake Maumee and carved an entrenched channel 50 to 125 feet deep in the till plain. This channel is now the course of the Wabash River from the northeastern corner of the county to Delphi. Upstream from Delphi, the flood plain of the Wabash is ¼ to 1 mile wide, or much narrower than it would have been if it had not followed the entrenched channel of the glacial stream. After the Wabash passes the rock barriers near Delphi, it follows a broad preglacial valley in which glacial material was deposited and later partly removed.

Steep bluffs and outwash terraces fringe the valley of the Wabash River and, at places where tributary streams enter, also wall the tributary valleys. Above Delphi, entrenchment of tributary streams, though evident near the Wabash, is inconspicuous a short distance back from the river. In this part of the county the tributaries rise in former marshes, sloughs, and in old glacial channels on the till plain. Along their upper courses, the streams have shallow valleys with gently sloping sides. Among the streams having shallow valleys are Rock Creek, Bachelor Run, Sugar

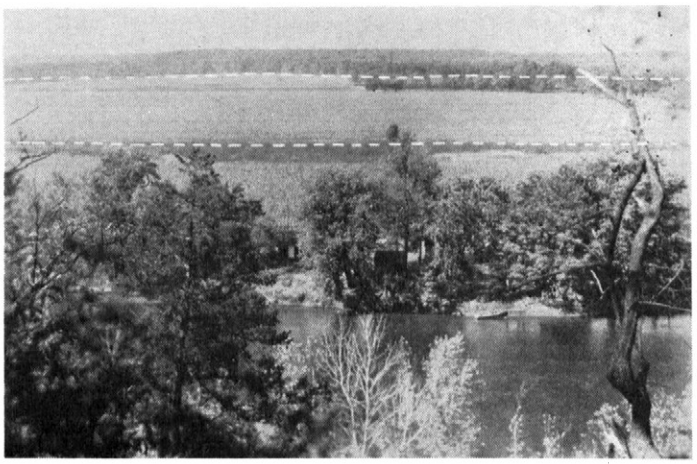


Figure 3.—View across Tippecanoe River Valley looking west toward Tecumseh Scout Camp. Dashed lines indicate separation between alluvial or first bottom soils in the foreground, Fox soils on the low terrace in the middle distance, and the bluff or steep slope in the background. Ockley soils occupy the high terrace above the bluff.

Creek, and Middle Fork Wildcat Creek. The lower reaches of Deer Creek and North Fork Wildcat Creek are deeply entrenched in the till plain.

The lower reaches of the Tippecanoe River are entrenched about 100 feet. The valley of the Tippecanoe River is bordered by broad, level, outwash plains that stretch northward to the sand plains of the Kankakee lacustrine section in White County.

Geology

Carroll County is almost entirely covered with glacial drift. In many places the deposit is up to 150 feet thick. The drift accumulated during the advance and retreat of great ice sheets. The geologic materials are of two kinds: (1) till, or compact, relatively unassorted silt, clay, sand, and some gravel; and (2) outwash, or water-assorted sand and gravel. Both kinds of materials contain considerable amounts of ground-up limestone and shale.

Little is known about the bedrock of this area, because it is covered by the glacial drift. Silurian (Niagaran) dolomitic limestone derived from coral is exposed in quarries at Delphi and along Deer Creek in the eastern part of the county. Limestone of Devonian age underlies the northeastern part of the county. Shales of Devonian age outcrop near Delphi.

Climate

The climate of Carroll County is humid, temperate, and continental. Summers are warm and humid. Winters are moderately severe and marked by frequent sudden changes in temperature. Generally, the climate is pleasant, but there are periods of hot sultry weather in summer and a few long cold spells in winter. The growing season is long enough to allow most farm crops to mature.

Normal monthly, seasonal, and annual temperature and precipitation at Delphi, as compiled from records of the United States Weather Bureau, are given in table 1. The elevation at Delphi is 575 feet. Since the maximum range in elevation within the county is only 270 feet, the climate at Delphi is typical of that in the rest of the county.

The average winter temperature is 28.2°F., but the minimum is −26°, and the maximum is 72°. Variations in temperature are often sudden. The alternate freezing and thawing damage fall-sown small grains, alfalfa, and clovers. The plants are heaved out of the ground. Snow rarely lasts long enough to afford much protection for tender winter crops. Probably winter wheat is damaged most in low-lying areas where low temperatures and saturated soils cause a coating of ice to form over the plants. Some winter damage to crops may occur in any year, but the amount and frequency is not enough to discourage planting them.

The average summer temperature is 73.1°, but the maximum may be 107°, and the minimum, 37°. Extremes in temperature seldom affect crops unless they come during dry periods.

TABLE 1.—*Normal temperatures and precipitation at Delphi, Carroll County, Ind.*
[ELEVATION, 575 FEET]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1895)	Wettest year (1927)	Average snowfall
	°F.	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	30.1	64	−18	2.50	4.88	3.62	5.2
January	26.1	70	−26	2.67	2.64	1.45	8.5
February	28.3	72	−24	2.06	.90	2.34	6.3
Winter	28.2	72	−26	7.23	8.42	7.41	20.0
March	38.8	88	−3	3.16	1.06	3.82	4.5
April	50.4	93	13	3.49	1.97	6.58	.8
May	61.4	98	25	4.30	1.06	7.61	(3)
Spring	50.2	98	−3	10.95	4.09	18.01	5.3
June	71.2	102	37	3.94	1.42	4.32	0
July	75.4	105	41	3.40	2.68	3.73	0
August	72.8	107	37	3.31	2.69	2.60	0
Summer	73.1	107	37	10.65	6.79	10.65	0
September	66.1	104	25	3.44	2.81	4.63	0
October	53.4	93	15	2.57	.76	3.53	.1
November	40.4	80	−8	2.91	4.30	6.61	1.5
Fall	52.3	104	−8	8.92	7.87	14.77	1.6
Year	51.2	107	−26	37.75	27.17	50.84	26.9

[1] Average temperature based on a 70-year record, through 1955; highest and lowest temperatures on a 45-year record, through 1930.

[2] Average precipitation based on a 70-year record, through 1955; wettest and driest years based on a 68-year record, in the period 1886-1955; snowfall based on a 42-year record, through 1930.

[3] Trace.

The average frost-free season at Delphi is 153 days, or from May 3 to October 3. Local differences in relief may cause a longer or shorter frost-free period, but for the county as a whole, the season is long enough to allow the maturing of most farm crops. Corn, tomatoes, strawberries, apples, and peaches are the crops most often damaged by frosts. Crops in low spots in the upland or along the stream valleys are more frequently damaged than those in areas that have good air drainage. Unfavorable weather in spring that delays planting, or excessive moisture in fall, may delay harvesting of corn and soybeans so much that they are damaged by early frost. Killing frost has occurred as late as May 31 and as early as September 14. Crop damage is normally severe when these extremely late or early frosts occur.

The average annual precipitation is 37.75 inches. Of this total, 18.39 inches, or nearly 49 percent, comes in the frost-free growing season, which extends from May through September. Rainfall is normally heaviest in spring. Prolonged rains and cool weather in spring may cause poor germination of seed and make necessary the replanting of corn or similar crops.

In summer (*9*), much of the rainfall comes in heavy showers that are accompanied by strong winds. These showers are unevenly distributed. As a result, in small areas, corn may be damaged by drought and hot drying wind. The heavy showers cause considerable erosion on clean-tilled slopes.

Widespread droughts are infrequent, but they have occurred in 1930, 1934, and 1936. Even during droughts, total crop production is not greatly reduced, because there is usually enough water to mature hay crops and small grains. Pollen burning such as that occurring in 1952 may come 1 year out of 10.

The prevailing winds are from the west and south for most of the year. In summer, however, they blow more frequently from the southwest and south. Winds of 30 miles per hour or more are rare and do not last long. They normally accompany thunderstorms, more than 200 of which cross Indiana each year. Winds of hurricane velocity sometimes blow later in summer. Hailstorms are not common, but when they occur, they cause severe damage in small areas.

Because Indiana lies in the humid part of the United States, the average relative humidity is about 69 percent in July and 80 percent in January. The humidity in January is slightly higher than the average for most of the United States. The weather is moderately sunny in summer but cloudy in winter. The sun shines about 70 percent of the possible time in summer and 40 to 45 percent of the time in winter.

Water supply

Wells and springs supply abundant potable but hard water for livestock and for household use. Springs are common along the bluffs, usually at the base of slopes where bedrock or sand and gravel outcrop. Wells are shallow on the bottom lands and 20 to 25 feet deep on the low terraces.

On the higher terraces and on the till plain the depths to adequate supplies of water are more variable and uncertain. The depth to the water-bearing strata is determined by the thickness and composition of both the glacial till and the deposits overlying the till. Within the till, strata of gravel and sand are the source of most of the water. Since the glacial drift deposits are more variable in the moraines along the northern and southern borders of the county, water can be obtained at shallower depths in those areas than in the clayey drift that occupies most of the upland till plain. South of Camden there is an area where excellent water supplies are obtained from wells 20 feet deep, which reach through till to the underlying gravel. However, it is generally necessary to drill wells 75 to 100 feet or more on the till plain. The deeper wells usually terminate in the underlying bedrock at depths ranging up to 150 feet.

Vegetation

Most of the county was originally covered by a mixed stand of hardwood timber. The principal species on the well-drained uplands and terraces were white oak, black oak, and shellbark and pignut hickories, with somewhat less of sugar maple, black walnut, ash, elm, and tulip-poplar. The poorly drained areas had less of oak and hickory and more of cottonwood, ash, birch, willow, linn, and sycamore.

The prairie along Deer Creek, north to west of Pittsburg, had a parklike vegetation — scattered growths of mixed oak and hickory surrounded by prairie grasses. The droughty terraces had a cover of walnut, cherry, hackberry, haw, and such shrubs as blackberry, hazel, and plum.

Few stands of virgin timber remain. They have been removed or greatly modified by cutting of the more desirable species. The largest wooded areas are on the steep slopes. A few scattered woodlots are on the nearly level areas. Trees on many potentially arable areas will ultimately be removed.

Organization and Population

French explorers and traders visited the Carroll County area for the first time about 1700 (*8*). At that time all the area north of the Wabash River was Indian territory. The sale of government land at Crawfordsville (Montgomery County) on December 21, 1824 opened the area to the first permanent English settlers. The first tract of land, along Deer Creek south of the present site of Delphi, was bought by Henry Robinson on December 30, 1824.

Fear of the Indians and rumors of unhealthy living conditions slowed settlement during the first few years. Following the treaty of 1826, the Indians moved westward, and the county was organized by an act of the General Assembly dated January 7, 1828.

The earliest settlements were along Deer Creek, Bachelor Run, and Rock Creek. Most of the settlers came from southern Indiana, Pennsylvania, Ohio, Virginia, Kentucky, and later from North Carolina and New York. The settlers generally traveled down the Ohio River to Cincinnati and then overland to Lafayette, as the Robinson group had done, or followed the Ohio and Wabash Rivers to the area.

The population of the county was 16,152 by 1870, and 20,021 by 1900. The population then decreased to 15,049 in 1930, but since that time has gradually increased to 16,010 in 1950. The county is predominantly rural. Delphi, the county seat and largest town, had a population of 2,530 in 1950. Almost all the population is native-born white.

Industries

Industry in Carroll County is based on the collection and, to some extent, on the processing of farm produce. Grain elevators, feed mills, creameries, and collecting stations for cream, poultry, eggs, and livestock operate in the county. At the time this survey was made, there was a tile plant, a quarry for production of agricultural lime, an egg-crate factory, and several other small factories producing industrial products such as bus bodies and valves. The inadequate labor supply and lack of industrial facilities do not encourage development of manufacturing.

Transportation and Markets

Agricultural products were first moved to market by riverboat or on overland routes. The Wabash-Erie Canal provided another artery of transportation until abandoned following the construction of railroads. Three railroads, the Pennsylvania, the Wabash, and the Chicago, Indianapolis, and Louisville, now serve the county and connect it with the large industrial centers. Highways within the county make rapid bus and motor freight service possible.

Delphi, the largest town and principal trading center in the county, is not easily accessible to all parts of the county. Nevertheless, larger towns in adjoining counties and several small towns within the county provide good markets. Among these are Flora, Camden, Yeoman, Burlington, Deer Creek, Burrows, and Rockfield. In 1950, 88 percent of the farms in the county were less than 10 miles from the trading center visited most frequently.

Cultural Development and Improvement

The schools are consolidated, and most of them are located in small towns. In 1954, about 90 percent of the farms had telephones, and 97 percent had electric power from power lines. Farm homes and buildings are generally well kept, and many farms have home freezers, electric water pumps, electric hot-water heaters, electric washing machines, and labor-saving equipment such as grain combines and cornpickers.

Agriculture

The pioneers in this area were subsistence farmers who added to their food supply by hunting or fishing. Other supplies could be obtained only by long and tedious trips by riverboat or overland. Corn, pork, and venison, the principal foods, were supplemented by maple sirup and sugar. During the first few years many problems had to be overcome. The land had to be cleared of timber before crops could be planted; tillage was difficult because of the roots and stumps; and preservation of foods, particularly meats, was difficult because the supply of salt was limited. Corn and potatoes were the first crops planted in the spring. Wheat was seeded in the fall. As the supply of grain increased, cattle and hogs replaced game as a source of meat. Sheep were raised to provide wool for clothing. Flax was grown for its fiber and seed.

During the early development of the area, corn and wheat had to be taken to Lafayette for milling. The first water-powered mill in the county was built on Deer Creek in 1830. Some grain was taken by riverboat to New Orleans to be traded for other supplies. Shipment of grain to New Orleans increased after construction of the Wabash-Erie Canal to Evansville in 1853. Commercial agriculture was further developed by the construction of railroads, which allowed more rapid movement for all kinds of agricultural products to market. Drainage of the marshy and poorly drained areas also stimulated agriculture.

Crops

The acreage of principal crops and the proportion of farm income derived from agricultural products, as reported by the United States Census, are given in tables 2 and 3, respectively.

TABLE 2.—*Acreage of the principal crops and the number of bearing apple trees in stated years*[1]

Crop	1929	1939	1949	1954
	Acres	*Acres*	*Acres*	*Acres*
Corn:				
Harvested for grain	54,575	56,013	69,637	70,943
For silage	1,221	445	460	909
Hogged, grazed, and cut for fodder	7,843	1,474	1,875	979
Oats:				
Threshed	28,019	17,257	26,869	23,249
Unthreshed	693	476	200	(2)
Wheat threshed	21,291	18,325	20,669	15,555
Rye threshed	2,366	4,229	492	1,367
Soybeans for all purposes	5,654	17,780	15,784	22,712
All hay	13,948	14,963	14,918	16,663
Annual legumes cut or saved for hay	2,460	5,614	119	100
Timothy and clover, alone or mixed	10,182	4,892	9,986	10,170
Alfalfa	1,021	3,848	4,550	6,125
Small grains cut for hay	65	478	120	217
Other tame hay	220	131	143	51
Special crops, vegetables, and small fruits:				
Irish potatoes	456	293	14	6
All other vegetables and small fruits	494	652	333	202
	Number[3]	*Number*[3]	*Number*[3]	*Number*[3]
Apple trees	17,233	6,452	3,713	2,237

[1] As reported in U. S. Census.
[2] Not reported.
[3] Number in the census year, which is 1 year later than the crop year given at the head of the columns.

TABLE 3.—*Proportion of total farm income derived from various farm products sold or traded*

Crop	1929	1939	1944	1949	1954
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
All crops	25.8	39.9	17.9	21.8	28.7
Field crops, other than vegetables and fruits and nuts	(1)	39.0	17.0	21.3	28.3
Vegetables	(1)	.6	.7	.3	.2
Fruits and nuts	(1)	.2	.1	.1	.1
Horticultural specialties	(1)	.1	.1	.1	.1
All livestock and livestock products	73.6	59.9	82.0	78.1	71.2
Dairy products	(1)	8.1	10.8	7.1	5.1
Poultry and poultry products	(1)	7.8	11.1	7.3	5.1
Livestock and livestock products, other than dairy and poultry	(1)	44.0	60.1	63.7	61.0
Forest products	.6	.2	.1	.1	.1

[1] Not reported.

The principal grain crops are corn, oats, soybeans, wheat, and some rye. Timothy and clover (alone or mixed) and alfalfa are the main hay crops. The increasing emphasis on a livestock system of farming rather than a grain system is reflected in the higher proportion of alfalfa and other hay crops and in the lower acreage in small grains.

Grain crops

Grain crops are grown on about 57 percent of the land farmed in Carroll County. Corn is grown on more than half of the acreage in grain crops. It is used chiefly as a feed in livestock farming. Soybeans are increasing in importance as a cash crop. Although oats continues to be an important feed crop, its acreage, along with that of wheat, has declined in recent years. Soybeans and alfalfa have gained in importance.

Corn.—Corn is the most important crop, both in total acreage and value. It is the basic feed crop in the prevailing livestock system of farming. The total acreage of corn for grain increased from 54,575 acres in 1929 to 70,943 acres in 1954. The average yield per acre has also increased in recent years, largely because of the increased use of hybrid seed, improvement in tillage practices, and liberal application of lime and commercial fertilizer. The special adaptation of corn to the soils in this area also contributes to its importance among the crops. Both the acreage grown and the yields obtained are above average on the Genesee soils of the flood plains, on the dark-colored Westland and Abington soils of former marshlands and glacial drainageways, and on the Cope, Brookston, and Fincastle soils of the nearly level, dark-colored clay uplands.

Land to be used for corn is plowed either in fall or early in spring, depending on weather and soil type. Fall plowing encourages erosion and is therefore confined largely to level land. The ground is thoroughly harrowed or disked and then smoothed with a harrow or cultipacker before planting. Most farmers use modern machinery to prepare the seedbed, and 4-row planters are used where the acreage is large. Corn is planted in May—in normal seasons from May 10 to May 30. The earlier date is preferred by farmers having a large acreage and limited equipment. The later date is suggested for the control of the European corn borer. Hybrid seed has almost entirely replaced open-pollinated seed.

Use of commercial fertilizers has increased steadily. Applications of 200 pounds or more per acre are commonly used in the row or hill at the time of planting. Many farmers supplement the initial application by plowing down complete fertilizers or by providing side dressings of soluble nitrogen.

Methods of harvesting corn vary with the individual farmer. Most of the corn, particularly on the bottom lands and large level farms, is harvested by mechanical pickers. On smaller farms and on rolling slopes the corn is either shucked from the standing stalk or from the shock. Most of the corn is fed to livestock on the farm. According to the Seed Certification Service, about 215 acres, chiefly on black clay land, was used for production of hybrid seed corn in 1954.

Soybeans.—In acreage, soybeans rank third among the principal crops. They are grown mainly for grain, but a small acreage is grown for hay. The soybean industry developed rapidly following the erection of the first oil-processing plant and increased in importance as methods of extracting the oil were improved and as new uses for soybean products were found. The beans are grown most extensively on level soils where a grain system of farming is practiced. Since soybeans are well adapted to soils favorable for corn, they are extensively grown on many of the same soils, particularly the Genesee soils of the bottom land and the Fincastle, Cope, and Brookston soils of the till plain. They are also adapted to the somewhat droughty Fox and Ockley soils of the gravelly terraces.

Soybeans usually are grown following corn in the crop rotation. They have replaced oats to a considerable extent because of their higher value. The seedbed is prepared as it is for corn, and the beans are drilled either solid or in narrow rows about 2 feet apart. Early planting, preferably late in May or early in June, is desirable so that the beans can mature early enough to allow seeding wheat after the beans are harvested. For successful growth the crop must be cultivated several times to control weeds. On rolling land the beans should be planted solid and along the contour to control erosion. A winter grain crop or cover crop should be planted after the beans are harvested.

The popular and best-adapted varieties of soybeans are the Lincoln, Hawkeye, and Harosoy (*7*). The Harosoy, in addition to providing high yields, is an early maturing variety. For this reason it is best adapted where winter wheat must be planted following the soybean harvest. The beans are harvested almost entirely by combine and sold for cash at the elevator.

Wheat.—The decline in acreage of wheat in recent years results partly from government control of crop production and partly from the increasing importance of other crops, particularly soybeans.

Since wheat may follow any of several crops in the rotation system, the preparation of the seedbed and the method of planting depend largely on the preceding crops. If wheat follows corn, it is drilled between the rows of standing corn, or a seedbed is prepared after the corn is harvested. If a seedbed is prepared, the stubble is disked and the land smoothed with a harrow or drag before drilling the grain. Seeding in the corn row is most common on small farms and on rolling land. Where mechanized farming is extensively used, only a small proportion of the wheat is seeded in the standing corn. If wheat follows soybeans, the land is disked at the time the beans are combined, and the wheat is drilled immediately. If wheat follows other crops, the ground must be plowed and then disked before seeding the wheat.

Wheat is planted during the latter part of September or in the early part of October. The usual practice is to wait until the hessian fly ceases to be a danger, or until about September 28. Most farmers drill com-

mercial fertilizers with the seed. A topdressing of barnyard manure in winter or early spring is suggested, and this is done frequently, particularly on the livestock farms. Many farmers now apply a topdressing of soluble nitrogen early in spring.

Wheat ripens early in July. It is usually harvested with a combine. A few farmers cut it with a binder and place it in shocks to be threshed later. Small quantities are retained on the farm for seed, but most of the crop is sold for cash at the local elevator. In years when the supply of other feed is reduced, wheat is ground and fed to hogs, dairy cattle, and other livestock.

Only the soft red winter wheat varieties are recommended. Among these are Knox, Vigo, Saline, Dual, and Vermillion. Dual is resistant to the hessian fly and may be seeded early for winter forage. Vermillion is an early maturing variety noted for its extra winter hardiness (*3*).

Although wheat is grown throughout the county, it is better adapted to the light-colored soils of the uplands and terraces. When it is grown on the dark-colored former marshland soils, like the Brookston, Kokomo, Westland, and Abington, there is danger of too heavy growth of straw and failure of the grain to mature. If large quantities of phosphatic fertilizer are used to balance the extra nitrogen supply in these soils, lodging is less frequent and the crop matures better. On poorly drained soils, yields may be substantially reduced by drowning out of the plants. Wheat is poorly adapted to the flood plains, particularly those of the larger streams where the nitrogen content is high and the land is subject to frequent overflow.

Oats.—Oats, like corn, is an important feed crop in the prevailing livestock system of farming. In 1954, the crop ranked second to corn in acreage. The crop is grown on most of the soils, but some are less suited to it than others. The bottom-land soils that are flooded during the spring and the droughty soils on the gravelly terraces are not desirable for oats.

The oat crop is normally planted late in March or early in April, or as soon thereafter as weather permits. Early seedings are more likely to bring higher yields because the crop has a longer period of growth before hot dry weather begins. Since oats follows corn or soybeans in the rotation, the ground usually is disked before the grain is drilled. Plowing provides a better seedbed and thus better yields, but many soils do not dry early enough to permit early plowing. The practice of "mudding in the seed" to achieve an early planting is sometimes followed, but this usually results in thin stands and lower yields. The crop is harvested late in July or early in August. The methods of harvest are similar to those used for wheat. The grain is used on the farm for feed or sold at the local elevator.

The suggested varieties of oats for this area are Clintland, Newton, Bentland, Clinton 59, and Benton (*3*).

Rye.—Rye is a minor grain crop. Methods of seeding and harvesting are similar to those for wheat, but seeding is usually done earlier in fall. Little of the rye is fertilized. Rye is pastured in the fall and for a few weeks in the spring before other pasture is available. The grain usually is ground and used as feed for hogs and other livestock. Balbo rye is superior to common rye as pasture.

Other grains.—Barley and buckwheat are grown on a small acreage. Normally they do not have a place in the crop rotation, but are grown where some other crop has failed. Barley is adapted to a cool climate and soils that are neutral in reaction and naturally well drained. Winter varieties of barley are preferred to spring varieties. Kentucky No. 1 provides the highest yields among the winter varieties. Buckwheat can be seeded any time from late May to August and still mature. For this reason it is sometimes grown on bottom lands where corn has been drowned by late spring floods.

Hay crops

The acreage of hay crops has been about the same for the last 45 years. However, there is a trend toward using crops with a higher protein content, such as alfalfa or mixed grasses and legumes, rather than timothy and clover.

Alfalfa.—The acreage of alfalfa has increased rapidly, as shown by table 2. This increase may be attributed to a better understanding of its requirements—particularly its need for inoculation and lime and plant nutrients—and to a greater appreciation of its feeding qualities. Alfalfa is seeded in the fall, with or without a nurse crop, or in the spring with wheat or oats. If it is seeded in the fall, a good seedbed free of weeds must be prepared and the soil packed by a cultipacker or roller to maintain a good moisture supply near the surface. Most of the soils must be limed for alfalfa. The general practice has been to add ground limestone until the soil reaction is pH 6.0 or higher. Inoculation of seed is essential if alfalfa is to grow well and add nitrogen to the soil.

Western common alfalfa is usually grown. Where winter hardiness is a problem, the variegated kinds, particularly Grimm, are grown. The wilt-resistant varieties, Ranger and Buffalo, are suggested where stands are to be kept 3 years or more.

Alfalfa can be grown on most soils of the county. It is extensively grown where livestock farming is practiced and on naturally well-drained soils, particularly sandy soils and those underlain by gravel and sand. The highest proportion of alfalfa is grown on members of the Fox, Ockley, Oaktown, Miami, and Russell series. The crop is least suited to soils that are poorly drained or subject to flooding.

Clover.—The acreage of clover seeded alone has declined. Mixed seedings of grasses and legumes are grown to reduce losses incurred when a single-crop seeding fails.

Red clover tolerates greater soil acidity than either alfalfa or sweetclover, but best results are obtained if lime has been added to bring the pH value to 6.0 or higher. Alsike clover tolerates even greater soil acidity and is sometimes grown where red clover has failed because of acidity or poor natural drainage. Inoculation of clover seed is required where clover has not been grown before.

Clover usually is seeded in March, either in wheat or rye, or with oats. After the grain is harvested, clover is sometimes pastured and then later in the season cut for hay. Common red clover is first cut for hay and, if cut again in the fall, is usually cut for seed. Hay is used on the farm or sold to livestock farmers in surrounding areas. Mammoth red clover is grown largely as a pasture and soil-improvement crop.

Although grown on most soils of the county, clover is not well suited to the following soils: Genesee and Eel soils, where flooding is frequent; the depressional Kokomo soil, where the crop may be drowned by standing water; or sandy Oaktown and gravelly Fox soils, where the crop may be killed by drought.

Timothy.—The acreage seeded to timothy alone has declined because of the greater acreage used for mixed grasses and legumes. Nevertheless, timothy is sometimes seeded alone where soils are too acid for clover or if the price of red clover seed is too high. Stands consisting largely of timothy also occur where the legume in a mixed legume-timothy seeding has failed.

Other hay crops.—Hay crops grown to a limited extent are sweetclover, soybeans, lespedeza, bromegrass, rape, millet, and sudangrass. Sweetclover is grown primarily as a soil-improvement crop, but it is sometimes used as pasture or grown for seed. Like alfalfa, it requires a pH value of 6.0 or higher, and preferably 7.0. The seed must be inoculated. Most sweetclover is seeded in wheat, or with oats in the spring. Sometimes sweetclover is sown with alfalfa and timothy. Sweetclover is also sown as an intercrop in a 2-year rotation of corn and wheat or in a 2-year rotation of oats and corn.

Other legumes grown for hay, but on small acreages, are soybeans and lespedeza. Lespedeza is grown mainly on the dark-colored prairie soils west and northwest of Delphi and on the dark-colored depressional Brookston and Westland soils. Bromegrass has been grown with alfalfa in place of timothy. It is more often used as a pasture than as a hay crop. Some rape is grown as pasture for hogs. Millet and sudangrass usually are grown to supplement other pastures or to provide pasture if other pastures fail. They are also grown as a supplementary hay crop.

Weedy meadows are common on land where either the grass or the legume has failed to develop. The production of hay and the carrying capacity of the meadow is low in such areas.

Vegetables

Vegetable crops are grown in many small areas for local consumption and home use. Tomatoes and sweet corn are sold on the local market or to canneries located at Klondyke and Frankfort, Ind. Tomato yields are usually high on the fertile dark-colored soils that are rich in organic matter, such as Brookston and Westland silty clay loams, but tomatoes of slightly higher quality are reported to be grown on the light-colored Russell, Miami, Fincastle, and Crosby soils.

Sweet corn is grown mainly for sale to canneries. Productive dark-colored soils and alluvial soils are preferred. Puregold or Golden Cross Bantam are the hybrid varieties commonly grown.

Permanent pastures

Most farms in Carroll County have some land in permanent pasture. However, most permanent pastures are on sloping to moderately steep soils along the major streams or on bottom lands along small streams. The better grade pastures consist primarily of Kentucky bluegrass and whiteclover. The lower grade or weedy permanent pastures are more common on eroded slopes and loose sandy soils in stream valleys. Poor-grade pastures contain bluegrass and varying amounts of povertygrass, red sorrel, cinquefoil, broomsedge, and annual weeds.

Most poor pastures can be improved by applying ground limestone as needed, disking in liberal quantities of fertilizers that are high in phosphorous and potassium, and then reseeding with a grass-legume mixture.

Livestock and Livestock Products

Livestock and livestock products have been the major source of farm income in Carroll County for many years. Income from corn, oats, other small grains, and hay crops is derived largely through feeding livestock for sale. In 1954, sale of livestock and livestock products accounted for 71.2 percent of the total farm income in the county. Table 4 shows the number of livestock on farms for stated years.

TABLE 4.—*Number of livestock of all ages on farms*

Livestock	1930	1940	1950	1954
Horses and mules	5,429	[1] 1,731	405	257
Cattle	18,491	[1] 18,496	23,048	28,701
Swine	[1] 37,353	[2] 46,350	107,494	120,098
Sheep	12,204	[3] 4,632	4,962	6,052
Chickens	[1] 149,496	[2] 131,764	[2] 144,249	[2] 187,500
Other poultry	[4] 13,863	[4] 5,415	[4] 3,398	7,274

[1] Over 3 months old.
[2] Over 4 months old.
[3] Over 6 months old.
[4] One year earlier than year given at head of column.

Beef cattle

Beef cattle are raised throughout the county. Abundant supplies of corn and roughage have favored the development of the beef cattle industry. Since most farmers are engaged in fattening beef cattle rather than in breeding enterprises, cattle are shipped to the area from the western states. Most cattle are bought when small, grazed during the summer, and finished on commercial concentrates. Larger cattle may be bought in the summer and fattened for a few months late in fall and in winter. The cattle are sold through local markets or on the Indianapolis market. Shorthorn, Aberdeen-Angus, and Hereford are the principal breeds.

Dairy cattle

In 1954 dairy products accounted for 5.1 percent of the total farm income; however, only 40 farms, or 2.3 percent of the farms, were classified as dairy farms. Commercial dairies near towns and in the Lake Freeman resort area provide a local market for milk. Whole milk and cream also are collected by truck and transported to the larger cities in nearby counties for processing. Feed for dairy cattle consists mostly of corn, oats, and hay, produced on the farm, and commercial concentrates. Holstein-Friesian and Guernsey are the principal breeds. In addition, there are some Jerseys and milking Shorthorns and a number of mixed-breed dairy cattle.

Hogs

Hog raising is probably the most important livestock enterprise. It is usually done along with beef-cattle raising and is likewise distributed throughout the county. The high-quality legume meadows and rotation pastures and the abundant supply of corn favor hog raising. Hampshire and Poland China are the principal breeds, but many hogs of Berkshire, Duroc-Jersey, and Chester White breeds are also raised. Except for protein supplements, most of the feed is grown on the farms. Hogs are marketed largely through Indianapolis and local markets.

Sheep

Sheep raising is of minor importance. Many small flocks are kept on farms to control weeds in rolling pasture areas. A few farmers buy sheep from western markets and fatten them on the better bluegrass pastures and surplus roughage. Sheep and lambs are trucked to the Indianapolis market.

Poultry

On most farms poultry raising is a minor enterprise. The flocks average about 100 chickens per farm. They are kept mainly as a source of meat and eggs. The surplus is sold to farm buyers or in nearby towns. Barred Rock and White Rock are the more common breeds, but a few farmers keep the heavier meat-producing breeds. Farms having larger flocks, 300 to 400 laying hens, specialize in the breeds that lay more eggs, principally the Leghorn. In 1954, 50 farms received more than 50 percent of their total farm income from poultry and poultry products.

Work stock

Tractors have largely replaced horses and mules. Most of the 257 draft animals reported in 1954 are kept on small, or partially mechanized, farms along the Wabash River and its tributaries.

Land Use, and Size and Type of Farms

In 1954 the 227,027 acres in farms was used as follows:

	Acres
Cropland harvested	153,470
Cropland used only for pasture	26,944
Cropland not harvested and not pastured	2,815
Woodland pastured	16,700
Woodland not pastured	7,912
Other pasture (not cropland and not woodland)	6,355
Other land (house lots, roads, wasteland, etc.)	12,831

Farms were classified by size in the 1954 census as follows:

Size of farms (acres)	*Number*
Under 10	189
10 to 49	236
50 to 99	273
100 to 179	465
180 to 259	280
260 to 999	201
1,000 and over	1

The number of farms, average size, and land in farms in stated years are given in table 5.

TABLE 5.—*Number of farms, average size, and land in farms*

Year	Farms: Number	Farms: Average size	Land in farms: Total	Land in farms: Proportion of land in farms	Land in farms: Proportion of farm land improved	Land in farms: Improved land per farm
		Acres	*Acres*	*Percent*	*Percent*	*Acres*
1930	1,813	121	219,957	91.2	[1] 81.6	[1] 99
1940	1,742	128	223,065	93.2	[1] 81.9	[1] 105
1950	1,737	133	231,981	96.9	[1] 80.3	[1] 107
1954	1,645	138	227,027	94.8	80.7	111

[1] One year earlier than year given in first column.

Farms are classified by type in the 1954 census as follows:

Type of farm:	*Number*
Field-crop farms other than vegetable and fruit and nut	415
Dairy farms	40
Poultry farms	50
Livestock farms other than dairy or poultry	781
General farms	120
Primarily livestock	15
Crop and livestock	105
Miscellaneous and unclassified farms	265

Farm Tenure

According to tenure of operator, the 1954 census divides the number of farms and acreage in farms as follows:

Tenure of operator:	*Number of farms*	*Land in farms (acres)*
Full owners	806	63,986
Part owners	305	68,207
Managers	4	362
All tenants	530	94,472

Share tenants and croppers operate approximately 78 percent of the 530 farms operated by tenants; share-cash tenants, 7 percent; cash tenants, 4 percent; and other unspecified tenants, the remaining 11 percent. Share tenants receive one-third to one-half of the crops or livestock, and the tenant gets living quarters, space for a garden, a cow, and pasture. Tenants provide the farm equipment. Seed and fertilizer costs are divided as agreed upon. On farms where the risk of crop failure is greater, particularly farms on bottom lands or on infertile soils, the tenant may receive a larger share. Little land is rented for cash. Rental prices vary with the productivity of the soil, farm improvements, and current economic conditions.

Farm Equipment and Expenditures

Equipment on farms was reported in the 1954 census as follows:

	Farms reporting	*Number*
Grain combines	836	847
Corn pickers	1,036	1,037
Pick-up hay balers	246	246
Tractors (wheel tractors other than garden)	1,316	2,139
Motortrucks	851	942
Automobiles	1,581	2,019

The investment in farm equipment has increased along with the change to tractors. Plowing, seedbed preparation, and cultivation are done almost entirely by power machinery. Corn is harvested largely by mechanical pickers, and small grains and soybeans by combines. Mechanized harvesting of hay is not so uniformly practiced. The proportion of custom-owned or cooperatively owned equipment used in making hay or harvesting grain is also increasing.

In the 1954 census specified expenditures were reported as follows:

	Farms reporting expenditure	*Percent of total expenditure*
Machine hire	865	13.6
Hired labor	826	13.0
Feed for livestock and poultry	1,436	22.6
Gasoline and other petroleum fuel and oil.	1,361	21.4
Commercial fertilizer	1,321	20.8
Lime and liming haterials	546	8.6

Hired labor is used more extensively during the harvest season, but the seasonal labor requirement is not great. The number of farms reporting and the expenditure for machine hire and hired labor decreased from that reported in 1949. The number of tractors and other equipment reported in 1954 was greater than that reported in 1950.

Nature of the Soils, Suggested Management, and Estimated Yields

This section has three main parts. The first presents, by means of small maps, the characteristics of

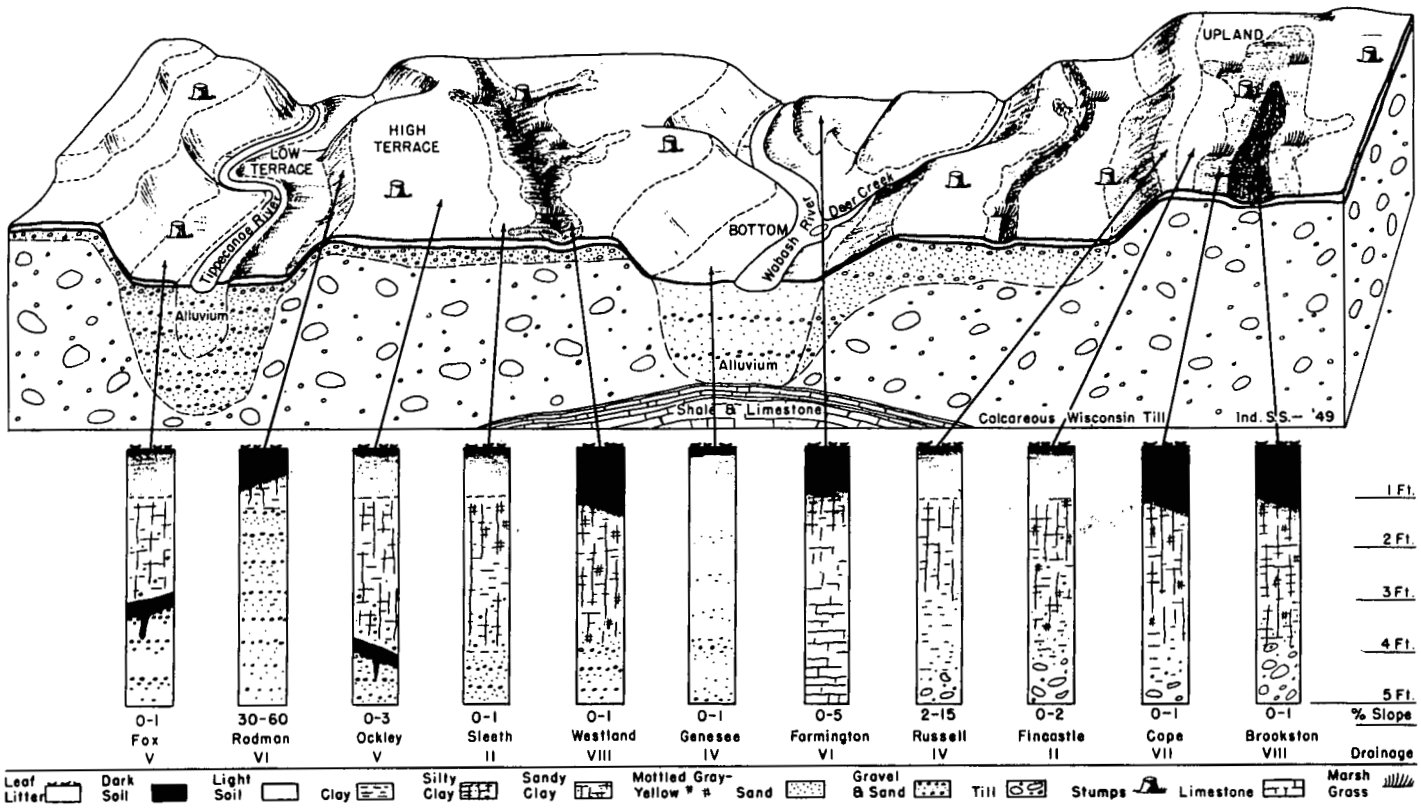
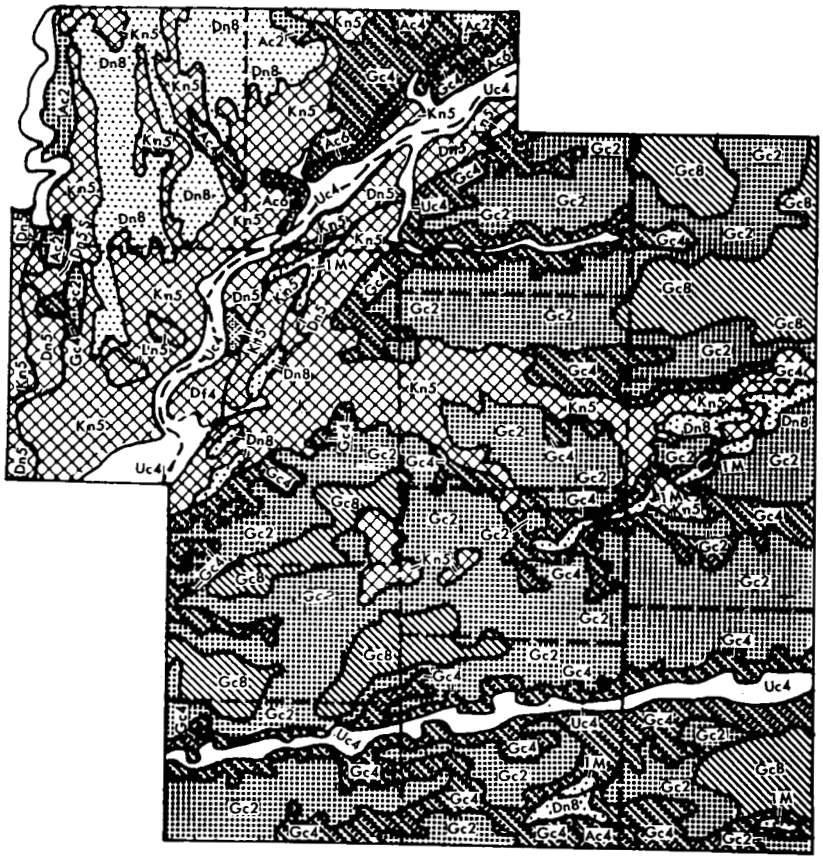
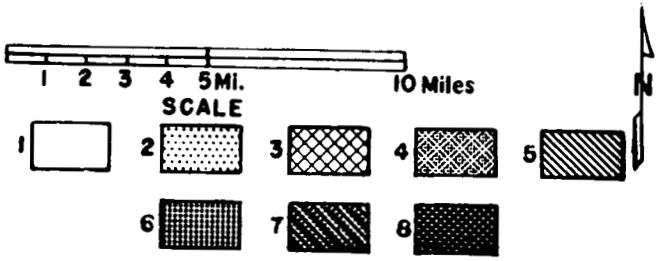


Figure 4.—**Schematic cross section of west-central Carroll County showing soil series, parent material, native vegetation, and drainage. Roman numerals below each profile indicate drainage as follows: II, imperfect; IV, good; V, good to excessive; VI, excessive; VII, poor; and VIII, very poor.**





EXPLANATION

Level bottom:

1. Uc4---------- Floodplains of streams.

Level terrace:

2. Dn8, 1M---------- Swales and depressions.

3. Dn5, Dn5S, Df4---------- Lower benches 5 to 10 fe floodplains with moder breaks.

Kn5, Ln5---------- Higher benches with break variable steepness.

Irregularly rolling terrace:

4. Kt5---------- Sand dunes on terraces bo bottoms.

Nearly level upland:

5. Gc8---------- Swales and depressions.

6. Ac2, Gc2---------- Nearly level to very gent till plain with minor i knolls and depressions.

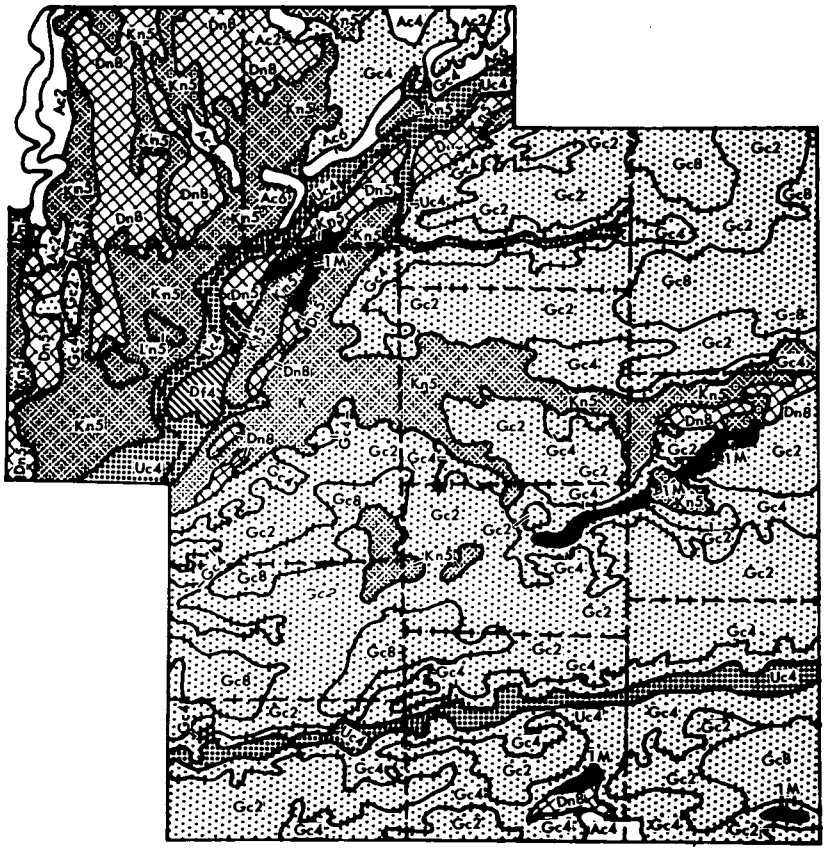
Moderately sloping upland:

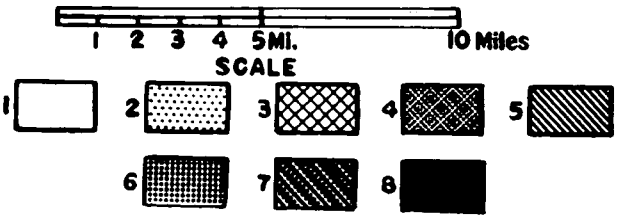
7. Ac4, Gc4---------- Knolls and undulating are plain and moderately sl along streams.

Steep upland:

8. Ac6---------- Breaks bordering the Waba

Figure 5.—**Topographic position of the soils of Carroll County, Ind.**





EXPLANATION

Morainic uplands along northern and southern borders:

1. Ac4, Ac2, Ac6--------- Relatively nonassorted, med highly calcareous till le carbonates to depths of 2

Upland throughout county:

2. Gc4, Gc2, Gc8--------- Material similar to that of but 18- to 36-inch mantle and leached of carbonates 42 to 60 inches.

Low-lying terraces of major streams:

3. Dn5, Dn8, Dn5S-------- Highly calcareous gravel an of carbonates to depths o inches.

Higher, older terraces and outwash plains:

4. Kn5, Ln5---------- Material similar to that of but leached of carbonates 42 to 70 inches.

Rock terraces in Wabash River Valley:

5. Df4---------- Shallow noncalcareous drift shale, or both.

Bottoms of all streams:

6. Uc4---------- Neutral to slightly alkalin sand from Wisconsin drift

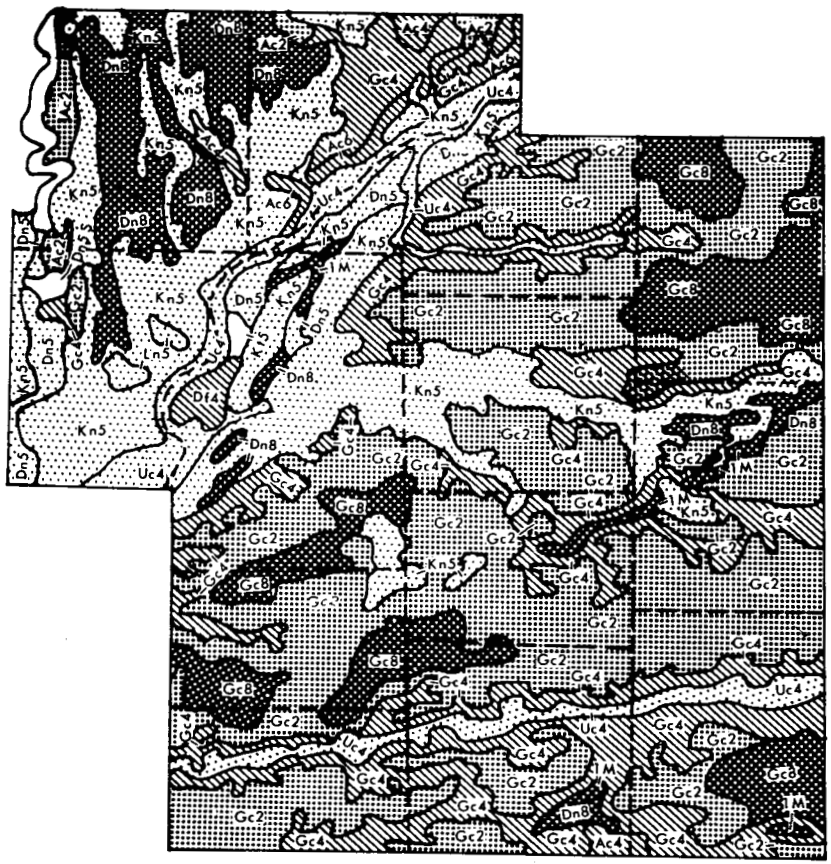
Dunes on terraces bordering bottoms:

7. Kt5---------- Wind-deposited uniformly as sands, largely noncalcare

Former lakes and marshes:

8. lM---------- Organic, or vegetative, mat

Figure 6.—**Parent materials of soils of Carroll County, Ind.**



EXPLANATION

1. Very rapid to excessive:

   Kt5---------- Dunes on terraces north o of 3 feet of slightly c soil over deep loose sa

   Dn5S---------- Stream terraces in Tippec composed of 2 to 3 feet friable soil over 3 to or sand.

2. Rapid:

   Ln5, Kn5, Dn5---------- Nearly level stream terra 3 to 6 feet of permeabl and gravel; high terrac underlain by till at de or more.

   Uc4---------- Permeable, loamy soil of subject to overflow; wa with fall of stream.

3. Medium:

   Df4, Gc4, Ac4, Ac6-------- Sloping areas composed of till; some rainfall is

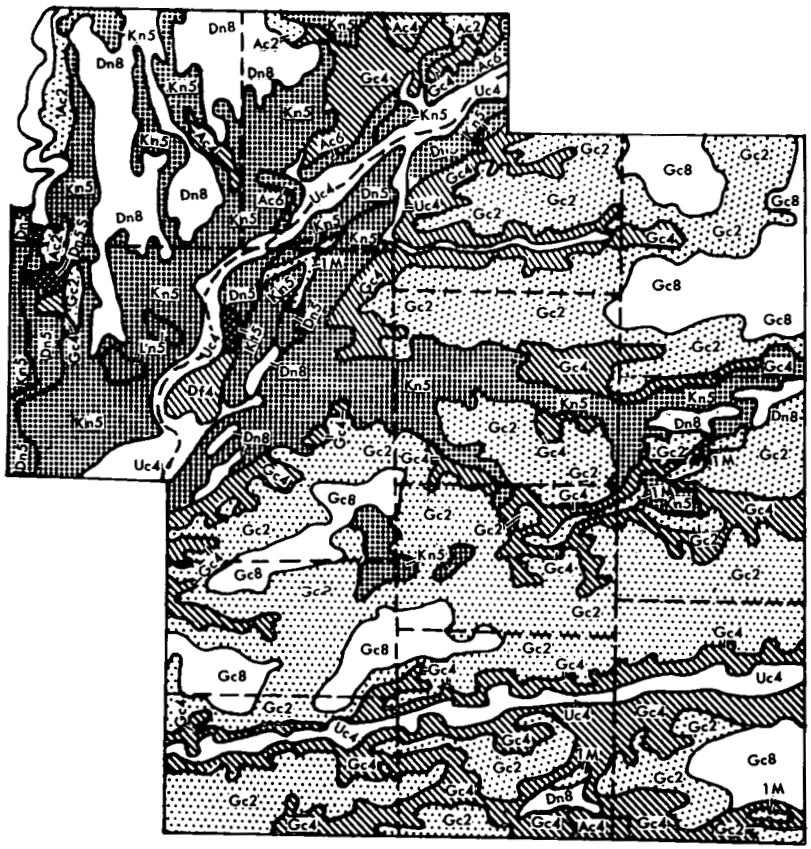
4. Slow:

   Ac2, Gc2---------- Nearly level upland areas permeable till over hea material.

5. Very slow:

   1M, Gc8, Dn8---------- Swales and depressions wh higher areas accumulate materials are organic m material (1M); slowly p (Gc8); and permeable gr (Dn8).

Figure 7.—**Internal drainage of soils in Carroll County, Ind.**



EXPLANATION

1. Very high:

Gc8---------- Dark-colored upland soils, in swa
sions, that are rich in organic
receive extra moisture from sur
areas.

Dn8---------- Soils in swales and depressions o
gravelly terraces with relative
table.

Uc4---------- Bottom soils subject to overflow
moisture sufficient for all cro

2. High:

Ac2, Gc2---------- Light- and dark-colored, deep, mo
soils of level uplands over com
textured glacial till.

1M---------- Organic soils of the deep depress

3. Moderate:

Ac4, Gc4, Df4------- Deep, moisture-retentive soils or
areas (Ac4, Gc4) where much rai
because of runoff, and shallow
deep soils of low terraces (Df4

4. Low:

Ln5, Kn5---------- Terrace soils 4 to 6 feet deep ov
ture supplying capacity reduced
to underlying material decrease

Dn5---------- Terrace soil; underlying material
above group, but depth of soil

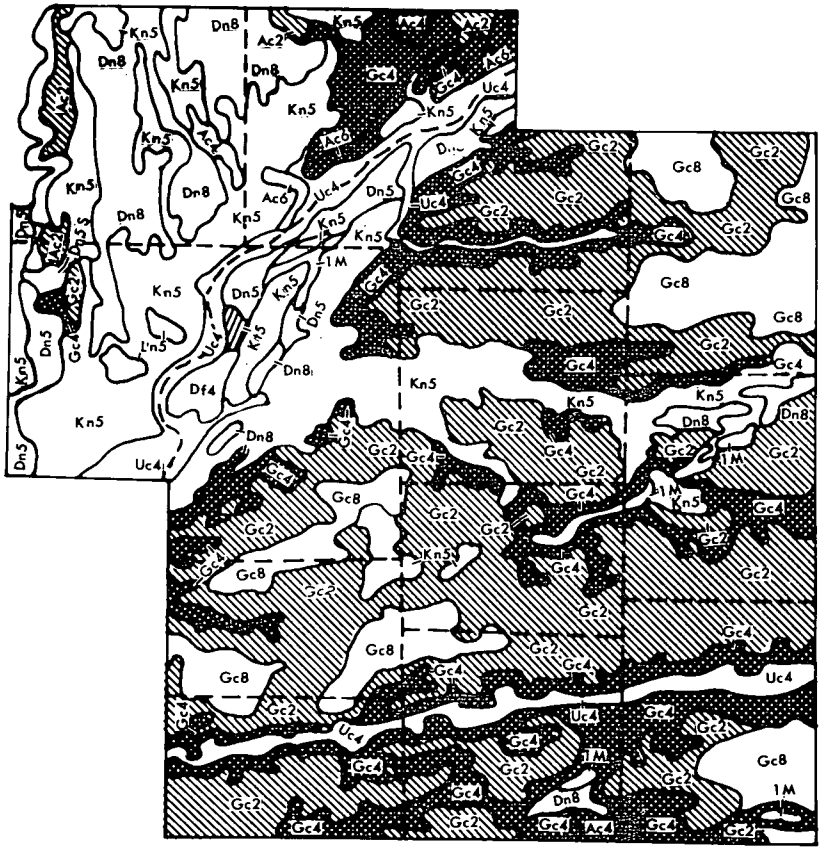
Ac6---------- Soils or steep slopes, principall
Wabash Valley; surface drainage
of soil varies because of erosi

5. Very low:

Dn5S---------- Dark-colored sandy terrace soils
Tippecanoe River; gravel and sa
3 to 4 feet; rapid internal dra

Kt5---------- Deep, loose, light-colored dune s
areas on east side of valleys o
and Wabash Rivers.

Figure 8.—Drought resistance of the soils of Carroll County, Ind.



EXPLANATION

1. Little or no erosion:

   Uc4---------- Soils of bottom land where som may occur during overflow.

   Dn8, Gc8, 1M-------- Soils of terrace and upland sw material from higher areas i

   Kn5, Ln5, Dn5------- Soils on nearly level terrace Dn5S, Df4 of which are susceptible to

2. Slight erosion:

   Ac2, Gc2---------- Nearly level, light-colored up gently sloping soils are inc susceptible to moderate eros

   Kt5---------- Undulating dune sands susceptil erosion.

3. Moderate to severe sheet erosion and occasional gullies:

   Ac4, Gc4, Ac6------- Soils on light-colored rolling slopes along streams that ha or overgrazed.

Figure 9.—**Erodibility of the soils of Carroll County, Ind.**

the soils that most affect their suitability for agriculture. The second suggests, for all the soils mapped, methods of management that will conserve them and maintain their productivity. The third provides estimated yields and productivity ratings for the soils under two levels of management.

General Nature of the Soils

This section introduces the soils of Carroll County. It provides a schematic cross section showing how soil series occur in part of the county (fig. 4). Following the diagram are maps that show, respectively, the topographic position, parent materials, internal drainage, drought resistance, erodibility, and lime requirements of the soils.

These maps serve as guides to the general nature of the soils in the county, and to the kinds of problems that will be met in planning their management. For more detailed information about the soils, the reader should turn to the section Soil Series, Types, and Phases. That section describes, in detail, each soil shown on the map sheets that have been placed at the end of this report.

The symbols on the small maps—Ac2, Ac4, and so on—indicate the dominant soils within the boundaries shown on the maps. Following is a list of the 15 symbols used and the soils represented by each.

Ac2 Crosby silt loam, Brookston silty clay loam.

Ac4 Miami silt loam, Crosby silt loam.

Ac6 Hennepin loam.

Dn5 Fox silt loam, Fox loam.

Dn5S Fox fine sandy loam.

Dn8 Westland silty clay loam, Abington silty clay loam, Homer silt loam, Fox loam.

Gc4 Russell silt loam, Fincastle silt loam, Cope silt loam, Cope silty clay loam.

Gc2 Fincastle silt loam, Cope silt loam, Cope silty clay loam, Brookston silty clay loam.

Gc8 Brookston silty clay loam, Cope silty clay loam, Cope silt loam, Fincastle silt loam, Kokomo silty clay loam.

Kn5 Ockley silt loam, Ockley loam.

Ln5 Longlois silt loam.

Df4 Farmington silt loam, Milton silt loam, Millsdale silty clay loam.

Kt5 Oaktown loamy fine sand, Lyles loam.

Uc4 Genesee silt loam, Genesee loam, Genesee fine sandy loam, Eel silt loam, Eel silty clay loam, Ross silt loam, Ross silty clay loam, Ross loam.

1M Carlisle muck, Edwards muck.

Topography

Topography, or lay of the land, affects the rate of runoff and amount of erosion. It is therefore one of the most important factors to be considered in use and management of farms and fields. Figure 5 shows the topography of the soils in Carroll County. As shown in this figure, the proportion of steep or severely eroded soils is very low. Areas of level to nearly level soils are extensive. In the level or nearly level areas, runoff is slow wherever the subsoils are slowly permeable. (See fig. 7, on internal drainage.)

Parent materials

Parent materials have much to do with the texture, mineral composition, fertility, drainage, and moisture-holding capacity of soils. Figure 6 shows which soils have developed from about the same kind of parent material.

As the figure indicates, only a small part of the soils have developed from organic, or vegetative, material. Furthermore, in only a few places has bedrock been near enough to the surface to contribute parent material. The soils of the county have formed largely from nonassorted glacial till, from assorted glacial outwash, and from wind-assorted sand and silt.

Internal drainage

Internal drainage, or movement of water through soil, is shown in figure 7. Most of the upland areas have slow internal drainage because they are underlain by relatively impermeable glacial till. The soils of the stream valleys and in gacial outwash areas that are on gravelly and sandy material have very rapid internal drainage. In the swales and depressions, ponded drainage prevailed until the land was artificially drained and cultivated. The most extensive ponded areas were on the broad upland divides between streams and in former glacial drainageways.

Drainage of sandy and gravelly areas is most often accomplished by digging widely spaced open ditches. Tile drainage is used more frequently on soils derived from the heavier glacial till.

Drought resistance

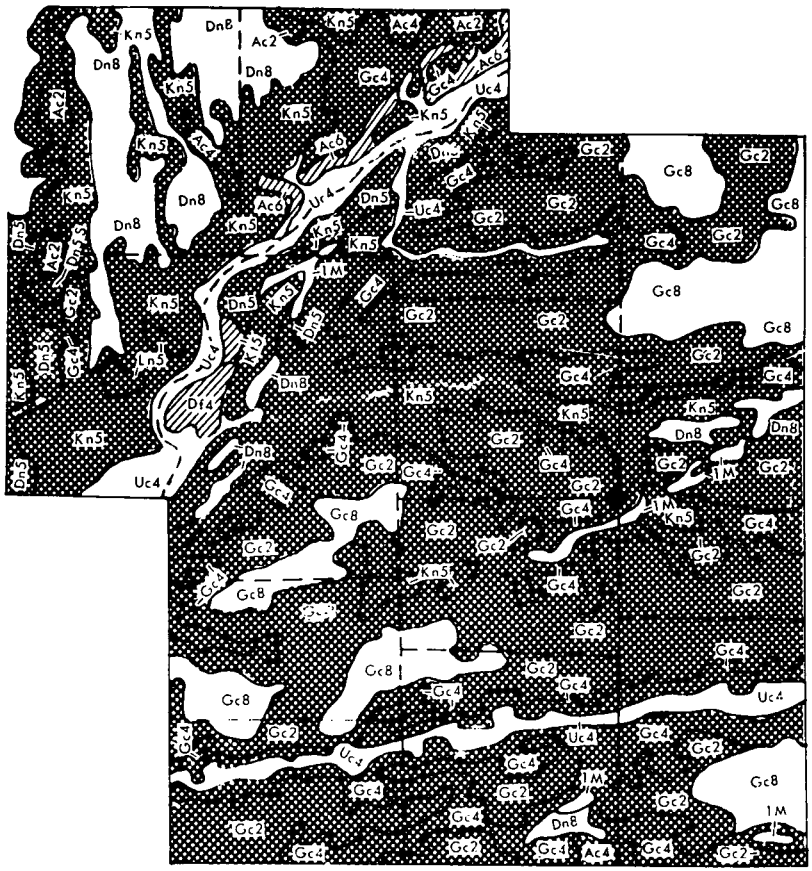
The drought resistance of soils depends upon the underlying material, position of the water table, organic-matter content, and depth and physical character of the soil. Figure 8 shows moisture-supplying capacity, or drought resistance, of the soils.

Erosion

Susceptibility of the soils to erosion is shown in figure 9. The figure indicates the risk of erosion on the soils if they are used for tilled crops.

Lime requirements

Lime requirements of soils are determined by their reaction, or active acidity, and the amount of lime needed to bring them to the reaction desired. Figure 10, though greatly generalized, shows lime requirements for the soils. About 39 percent of the county is occupied by soils that are neutral to slightly acid. There are no very strongly acid soils in the county.



EXPLANATION

1. No lime required:

Uc4----------	Bottom soils; neutral to alkali
1M----------	Organic soils, may be slightly is not required for the adapt
Dn8, Gc8----------	Terrace and upland soils in dep require some lime, particular colored soils on higher groun included in this group.

2. Up to 1 ton of ground limestone required:

Kt5, Df4----------	Dune sands and rock benches; re growth of deep-rooted legumes

3. Up to 2 tons of ground limestone required:

Ln5, Dn5S, Dn5, Kn5-Gc2, Ac2, Gc4, Ac4	Terrace and upland soils on hig 1 to 2 tons of ground limesto of red clover (except depress in this group); heavier appli to be required for sweetclove

Figure 10.—**Lime requirements for the soils of Carroll County, Ind.**

The need for lime depends on the crops to be grown and the depth to which the soil is acid. A single field may contain soils having different lime requirements. Consequently, soil tests should be made and the fields limed selectively. Of course, if the areas of different soils in a field are too small, selective liming may not be practical.

Suggested Management of the Soils [3]

This section is based on table 6, which lists the soils of the county by management groups and subgroups, and gives for each subgroup, suitable uses, suitable crop rotations, initial application of lime, fertilization at two levels, dominant management problems, and supplementary practices needed.

The soils in any one subgroup have about the same limitations, need about the same kind of management, and respond to that management in approximately the same way.

Because it is not practical to explain the important elements of management in a table, the text discusses crop rotation, liming, fertilization, organic matter, erosion, drainage, and drought resistance.

Crop rotation

A suitable crop rotation, if properly limed, fertilized, and protected from erosion or excess moisture, will provide good yields and conserve the soil. Table 6 gives suitable rotations for the soils of Carroll County, and supporting practices for them. The rotations suggested take into account the limitations of the soil and the fact that row crops deplete soils the most, that close-growing crops are less depleting, and that legume-grass mixtures are soil-building crops. For convenience of comparison, 20 crop rotations are shown in the following list in progressive order of their depleting effect on the soil.

Rotation: [1]

1. G-M-M-M
2. G-M
3. G-G-M-M
4. R-G-M-M-M-M
5. R-G-M-M-M
6. R-G-M-M
7. R-G-G-M-M
8. R-G-M-M-R-G-G(Sc)
9. R-G-M
10. R-G-M-R-G(Sc)
11. R-G-G-M
12. R-R-G-M-M
13. R-R-G-M
14. R-R-G-M-R-G(Sc)
15. R-G(Sc)
16. R-R-R-G-M-M-R-G(Sc)
17. R-R-R-G-M
18. R-R-R-R-G-M
19. R-R-G(Sc)
20. Continuous row crop, mainly corn.

[1] R=corn or soybeans; G=small grain; M=legume-grass meadow; (Sc)=intercrop of legume-grass mixture, usually including sweetclover, sown in small grain and plowed down for crop to follow. Each symbol indicates 1 year of the crop.

As shown in table 6, a more depleting rotation can be used on a soil if contour tillage, stripcropping, and terracing are practiced. The operator must decide whether he will use a less depleting rotation without conservation or a more depleting rotation with the conservation practices.

[3] Compiled with the assistance of Dr. S. A. Barber, Agronomy Department, Purdue University.

Whatever rotation is chosen, it is desirable to mix legumes with grasses in the sod crop. Alfalfa should be included in the legume-grass mixture wherever it can be grown successfully. Ladino clover should be part of the grass-legume mixture if the meadow is to be grazed. If legumes have not been grown on the soil before, the seed should be inoculated, and the acidity of the soil should be corrected by liming. Legumes will not grow successfully on acid soils. If a meadow is to remain 2 years or more, bromegrass is preferable to timothy in the seeding mixture because it is more drought resistant and higher yielding.

Liming

As shown in figure 10, much of Carroll County is occupied by acid soils. If the acidity of a soil is not corrected, plants cannot take full advantage of the nutrients that are in the soil or that are applied in commercial fertilizer.

Each field and each soil should be tested for acidity and then limed to meet the requirements of the crop to be grown. The county agricultural agent or the Plant and Soil Laboratory, Purdue University Agricultural Experiment Station, at West Lafayette, Ind., will provide instructions for sampling and testing soils.

Legumes, particularly, are sensitive to soil acidity. Where legumes are to be grown, enough lime should be applied to bring the pH level to 6.0 or 6.5. Alfalfa and sweetclover require a pH of 6.5 and 7.0, respectively. Table 6 gives the amount of lime needed to correct the acidity of soils that have not been limed.

Fertilization

The success of a crop depends much upon the supply of plant nutrients in the soil, mainly on the amounts of available nitrogen, phosphorus, and potassium. To get uniformly high yields on most soils of this county, it is necessary to add these elements in the form of commercial fertilizer. The amount of fertilizer to be applied will depend upon the need shown by soil tests, the kind of crop to be grown, and the management practiced. The need may be modified by drought or by other factors (*4*).

Rates for applying commercial fertilizer are given in table 6 at two levels: (1) average management for the farmer who wants immediate returns for a small investment in fertilizer, and (2) superior management for the farmer who wants to build up reserves of phosphorus and potassium and maintain a high nutrient level. The rates are based on the crop rotations suggested in the table, and it is assumed that soil tests show a medium need for phosphorus and potassium. For soils testing low in phosphorus and potassium, a higher rate of fertilization will be required.

Nitrogen.—The nitrogen supply in most soils of the county, and especially in the light-colored soils, is too low to permit top yields. Additional nitrogen usually is obtained by including legume hay crops and cover crops in the rotation. In some soils the supply of nitrogen becomes available too slowly to meet the needs

of maturing wheat, corn, oats, or similar crops. For these soils, nitrogen fertilizer must be added. Wheat requires nitrogen as a starter in fall, and it usually responds well if it is topdressed with 20 to 30 pounds of soluble nitrogen in the spring. The response is especially good on the light-colored soils. Corn requires additional nitrogen in summer just before and during the time the ears are filling. The need is especially great on high ground where the soils are light colored, eroded, or sandy. If tilth, drainage, and moisture supply are satisfactory, and the supply of phosphorus and potassium is adequate, 40 pounds or more of nitrogen can be plowed down or sidedressed for corn.

Phosphorus.—The supply of phosphorus in the soils has accumulated during the long process of soil formation. Only that part of it contained in the organic matter is readily available to plants. If the soil is acid, less of the phosphorus it contains is available to plants. Consequently, the supply of available phosphorus is larger in the dark-colored neutral and slightly alkaline soils of the bottom lands than in the other soils. Even in these soils, however, phosphorus is lost through removal of crops more rapidly than it can be restored through weathering of the soil material or through the return of crop residues and manures.

All crops, including hay and pasture, require phosphorus. Liberal amounts of phosphate fertilizer should be used. Much larger quantities should be applied than the crop actually needs. This should be done because much of the phosphorus applied will be fixed in the soil in a form not immediately available to the crop.

Potassium.—The supply of potassium is most abundant in the silty and clayey soils; it is very low in the sandy soils. Since most of the potassium remains in the inorganic form, little of it is lost through leaching. But the potassium in manure or crop residues is soluble and readily lost through leaching.

Frequently there is more potassium in the subsoil than in the surface soil. By using deep-rooted crops such as alfalfa and Ladino clover, this supply of potassium can be reached.

The supply of potassium is most deficient in (1) the organic soils derived from plant materials and (2) in the imperfectly drained, slowly permeable soils that have a heavy clay subsoil that restricts root development. Potassium added as commercial fertilizer readily becomes part of the supply of potassium in the soil. The finer textured soils hold potassium better than the coarse-textured soils.

The fertilizer rates in table 6 may be used in the following manner. Miami silt loam, 3 to 8 percent slopes, for example, is in management subgroup 1A. A 4-year rotation of corn, small grain, and 2 years of mixed grass-legume meadow is suggested. Under average management for soils of subgroup 1A, 20 pounds of P_2O_5 and 20 pounds of K_2O are suggested per year, therefore, 80 pounds of each would be applied over the 4-year period. If 200 pounds of 3-12-12 per acre is applied to corn in the row and 400 pounds is drilled with the small grain, there would be a deficit of 8 pounds of each for the rotation, or the equivalent of 66 pounds of 3-12-12. Under either level of fertilization, when the difference between the amounts needed and the amounts put on is large enough, a broadcast application can be used to make up the difference, and it can be put on either after the first cutting of second-year meadow or before plowing for corn. If the deficit is small it can be made up either by a change in the fertilizer analysis or by increasing the amount applied to small grains.

Erosion control

Removal of the original plant cover increases runoff and the risk of erosion. Erosion varies with the kind of soil, the length and steepness of slope, and the use and management practiced. Clean-tilled crops provide less protection than wheat or other close-growing crops, and the close-growing crops, in turn, provide less protection than sod crops.

Erosion of cultivated soils can be reduced by increasing their organic-matter content, by growing more cover crops or sod crops in the rotation, and by using contour tillage, stripcropping, terraces, and similar soil-conserving practices.

As shown in table 6, erosion is a dominant management problem on many soils of the county. The supplementary practices suggested in table 6, when applied in combination with a suitable rotation and level of fertilization chosen from that table, will protect the soils from erosion.

In studying the susceptibility of soils to erosion, it will be helpful to refer to figure 9, as it shows the location of areas that have (1) little or no erosion, (2) slight erosion, and (3) moderate to severe erosion.

Drainage

If plants are to grow properly, excess water must move down through the soil rapidly. Internal drainage must be good to a depth of 3 feet or more. In Carroll County, many of the soils were formed under impaired or poor natural drainage. The restricted drainage is indicated by the gray color of the surface soils and the mottling in the subsoils. Such soils are difficult to manage, have limited use, and produce low yields. They can be improved by artificial drainage. Then, the oxygen supply improves, deeper and stronger root systems develop, and plants are able to draw nutrients from the entire soil.

Table 6 indicates which soils of the county need drainage and protection from overflow. Refer to figure 7 for the location of large areas in the county that have (1) very rapid to excessive, (2) rapid, (3) medium, (4) slow, or (5) very slow internal drainage.

Conserving moisture

The resistance of a soil to drought should be considered in planning its management. For example, a heavy application of fertilizer to a droughty soil may be at least partly wasted because plants do not get enough moisture to use it. Addition of organic matter is one of the best ways of improving the moisture-holding capacity of droughty soils. Refer to figure 8

TABLE 6.—*Suggested use and management*

LIGHT-COLORED MINERAL SOILS

Management group and subgroup and soil type or phase	Suitable use	Crops well suited [1]	Crops not suited	Suitable	
				Without conservation practices	
				Grain system	Livestock system
Management group 1—Well-drained silt loam and loam soils:					
Subgroup 1A—Soils that are level to gently sloping:					
Russell silt loam, 0 to 3 percent slopes	Mixed grain and livestock farming	Alfalfa, wheat.		RRG (Sc)	RRG (Sc)
Russell silt loam, 3 to 8 percent slopes	Same	Alfalfa, wheat.			RGMMM
Miami silt loam, 3 to 8 percent slopes	Same	Alfalfa, wheat.			RGMMM
Milton silt loam, 0 to 5 percent slopes	Same	Alfalfa, wheat.			RGMM
Subgroup 1B—Soils that are gently sloping and eroded:					
Miami silt loam, 3 to 8 percent slopes, eroded.	Same	Alfalfa			GM
Russell silt loam, 3 to 8 percent slopes, eroded.	Same	Alfalfa			GM
Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded.	Same	Alfalfa			GGMM
Subgroup 1C—Soils that are sloping and eroded or erodible:					
Russell silt loam, 8 to 12 percent slopes.	Mixed grain and livestock farming.	Alfalfa			GMMM
Russell silt loam, 8 to 12 percent slopes, eroded.					
Miami silt loam, 8 to 12 percent slopes, eroded.					
Subgroup 1D—Soils that are sloping to moderately steep and eroded or erodible:					
Russell silt loam and silty clay loam, 8 to 12 percent slopes, severely eroded.	Permanent pasture and meadow.		Row crops		
Russell silt loam, 12 to 25 percent slopes.	Same				
Russell silt loam, 12 to 25 percent slopes, eroded.	Same		Row crops		
Russell silt loam and silty clay loam, 12 to 25 percent slopes, severely eroded.	Same				
Miami silt loam, 12 to 18 percent slopes, eroded.	Same				
Subgroup 1E—Soils steep or shallow to bedrock:					
Hennepin loam, 25 to 65 percent slopes.	Permanent pasture or forestry.		Row crops		Permanent pasture.
Rodman gravelly loam, 25 to 60 percent slopes.					
Farmington silt loam, 0 to 4 percent slopes.[6]	Permanent pasture and limited cropping.		Row crops		RGMM or RRGMMM.

See footnotes at end of table.

for the soils of Carroll County, Indiana

OF UPLANDS AND TERRACES

crop rotations [2]			Lime needed on land not limed [4]	Fertilization [5]						Dominant management problems	Other soil management practices needed and remarks
With conservation practices				Average management (pounds per acre per year)			Superior management (pounds per acre per year)				
Contour tillage [3]	Strip-cropping	Terracing		N	P_2O_5	K_2O	N	P_2O_5	K_2O		
			Tons per acre								Control runoff by contour tillage and grassed waterways, or by a combination of contour tillage and crop rotation. Terracing or stripcropping suggested for slopes greater than 2 percent and more than 200 feet long. On level areas of Milton silt loam, a rotation of RRGM can be used. A less intensive rotation than RRG(Sc) is suggested for slopes of 2 percent or greater on Russell silt loam, 0 to 3 percent slopes.
RGMM	RRGMM	RRGM	1–2	20 on wheat.	20	20	50 on corn. 20 on wheat.	25	40	Erosion	
RGMM	RRGMM	RRGM	1–2								
RGMM	RGMM	RGMM	0–1	20 on wheat.	20	20	50 on corn, 20 on wheat.	25	40	Erosion	
RGMM	RRGMM	RRGM	2	20 on wheat.	20	20	50 on corn, 20 on wheat.	25	50	Erosion	Control runoff by contour tillage and grassed waterways, or by a combination of contour tillage and crop rotation. Terracing or stripcropping suggested for slopes more than 200 feet long. Row crop should not follow a row crop, unless conservation practices are used.
RGMM	RRGMM	RRGM	2								
RGMMM	RGMM	RRGMM	3	20 on wheat.	20	25	20 on wheat.	25	50	Erosion	
RGMMMM	RGMMM	RGMM	1–3	20 on wheat.	20	25	20 on wheat.	25	50	Erosion	Use crop rotation and other practices to control runoff. For slopes longer than 200 feet, terracing or stripcropping is suggested.
GMMM	GMMM	RGMM	1–2					20	20	Erosion	Use legume-and-grass mixtures to renovate permanent pastures; practice rotational grazing and weed control.
GMMM	GMMM	GMMM	1–2					20	20	Erosion	
			0					20	20	Erosion	Use legume-and-grass mixtures to renovate pastures, as slope permits.
			0	20 on wheat.	20	20	40 on corn, 20 on wheat.	25	40	Shallow to bedrock.	Provide additional organic matter to improve moisture supply.

TABLE 6.—*Suggesteed use and management*

LIGHT-COLORED MINERAL SOILS

Management group and subgroup and soil type or phase	Suitable use	Crops well suited [1]	Crops not suited	Suitable	
				Without conservation practices	
				Grain system	Livestock system
Management group 2—Well to excessively drained silt loam and loam soils:					
Subgroup 2A—Soils that are level to nearly level:					
Longlois silt loam, 0 to 3 percent slopes.	Grain or livestock farming.	Alfalfa, wheat.	----------	----------	RRGMM------
Ockley silt loam, 0 to 3 percent slopes					
Ockley loam, 0 to 3 percent slopes					
Fox silt loam, 0 to 3 percent slopes					
Fox loam, 0 to 3 percent slopes	Grain or livestock farming.	Alfalfa, wheat.	Oats------	----------	RRGMM------
Nineveh loam, 0 to 3 percent slopes					
Subgroup 2B—Soils that are gently sloping:					
Ockley silt loam, 3 to 8 percent slopes	Grain or livestock farming.	Alfalfa, wheat.	----------	----------	RGMM------
Ockley loam, 3 to 8 percent slopes					
Fox silt loam, 3 to 8 percent slopes					
Fox loam, 3 to 8 percent slopes					
Subgroup 2C—Soils that are gently sloping and eroded:					
Ockley silt loam, 3 to 8 percent slopes, eroded.	Grain or livestock farming.	----------	Oats------	----------	RGMMM------
Ockley loam, 3 to 8 percent slopes, eroded.					
Fox loam, 3 to 8 percent slopes, eroded					
Fox loam, 3 to 8 percent slopes, eroded kame phase.					
Subgroup 2D—Soils that are sloping and eroded or erodible:					
Fox loam, 8 to 12 percent slopes	Limited cropping and meadow.	Alfalfa, wheat.	Oats, corn, and soybeans.	----------	GMMM------
Fox loam, 8 to 12 percent slopes, eroded.					
Fox loam, 8 to 25 percent slopes, eroded kame phase.					
Subgroup 2E—Soils that are sloping to moderately steep and eroded or erodible:					
Fox loam and clay loam, 8 to 12 percent slopes, severely eroded.	Limited cropping and meadow.	----------	Corn, oats, and soybeans.	----------	Permanent pasture or forest.
Fox loam, 12 to 25 percent slopes					
Fox loam, 12 to 25 percent slopes, eroded.	Permanent pasture or forest.	----------	----------	----------	----------
Fox loam and clay loam, 12 to 25 percent slopes, severely eroded.					
Management group 3—Excessively drained, sandy loam soils:					
Metea fine sandy loam, 3 to 8 percent slopes.	Livestock farming.	Alfalfa, rye.	Oats, red clover.	----------	RGMMM------
Fox fine sandy loam, 0 to 3 percent slopes.					
Management group 4—Excessively drained, loose sandy soils:					
Oaktown loamy fine sand, 3 to 10 percent slopes.	Limited cropping.	Rye, alfalfa, special crops; melons, peaches.	Oats, corn, red clover.	----------	RGMMM or special crops.

See footnotes at end of table.

for the soils of Carroll County, Indiana—(Continued)

OF UPLANDS AND TERRACES—(Continued)

crop rotations [2]			Lime needed on land not limed [4]	Fertilization [5]						Dominant management problems	Other soil management practices needed and remarks
With conservation practices				Average management (pounds per acre per year)			Superior management (pounds per acre per year)				
Contour tillage [3]	Strip-cropping	Terracing		N	P_2O_5	K_2O	N	P_2O_5	K_2O		
			Tons per acre								
----------	----------	----------	1–2	20 on wheat.	20	25	40 on first-year corn, 20 on 2nd-year corn.	25	50	Limited moisture supply.	Increase organic content and grow drought-resistant crops, such as alfalfa, bromegrass, wheat, and soybeans.
----------	----------	----------	0–1								
RRGMM-----	RRGMM---	----------	1–2	20 on wheat.	20	25	40 on corn, 20 on wheat.	25	50	Limited moisture supply and erosion.	Till along contour and use grass waterways to control runoff; increase organic-matter content and grow drought-resistant crops.
RGMMRGG (Sc).	RRGMM---	RRGMM----	1–2	20 on wheat.	20	25	20 on wheat.	25	50	Erosion	On slopes longer than 200 feet, stripcropping and terracing are required.
GMMM------	RGMMM--	RGMM----	2	--------	20	20	---------	25	40	Erosion	Provide cover of vegetation to protect remaining soil.
GMMM------	GMMM----	----------	1–2	--------	----	----	---------	20	20	Erosion	Control grazing and weeds and renovate pastures when needed.
----------	----------	----------		--------	----	----	---------	----	----	Erosion	Same.
----------	----------	----------	1–2	20 on wheat.	20	30	20 on wheat.	25	50	Limited moisture supply.	Increase organic content and grow drought-resistant crops.
----------	----------	----------	1–2	30 on wheat.	20	30	30 on wheat.	25	50	Very low moisture supply.	Protect exposed areas against wind erosion.

TABLE 6.—*Suggested use and management*

Management group and subgroup and soil type or phase	Suitable use	Crops well suited [1]	Crops not suited	Suitable: Without conservation practices: Grain system	Suitable: Without conservation practices: Livestock system
LIGHT-COLORED MINERAL SOILS					
Management group 5—Imperfectly drained, silt loam soils:					
Crosby silt loam, 0 to 3 percent slopes	Mixed grain and livestock farming.	----------	----------	----------	RRG (Sc)
Fincastle silt loam, 0 to 3 percent slopes					
Monitor silt loam, 0 to 3 percent slopes					
Sleeth silt loam, 0 to 3 percent slopes					
Homer silt loam, 0 to 3 percent slopes					
DARK-COLORED MINERAL SOILS					
Management group 6—Originally very poorly drained soils in depressional areas:					
Subgroup 6A—Soils of uplands and terraces underlain by clayey materials:					
Brookston silty clay loam, 0 to 3 percent slopes.	Grain or livestock farming.	Corn, soybeans, tomatoes.	----------	RRG (Sc)	RRRGM or RRRGMMRG (Sc).
Cope silt loam, 0 to 3 percent slopes					
Cope silty clay loam, 0 to 3 percent slopes.					
Kokomo silty clay loam, 0 to 3 percent slopes.					
Millsdale silty clay loam, 0 to 3 percent slopes.					
Washtenaw silt loam, 0 to 3 percent slopes.					
Subgroup 6B—Soils on terraces underlain by gravel and sand:					
Abington silty clay loam, 0 to 3 percent slopes.	Grain farming.	----------	----------	RRG (Sc)	RRRGM or RRRGMMRG (Sc).
Lyles loam, 0 to 3 percent slopes					
Westland loam, 0 to 3 percent slopes					
Westland silt loam, 0 to 3 percent slopes.					
Westland silty clay loam, 0 to 3 percent slopes.					
Subgroup 6C—Clayey alluvial deposits of terraces and bottoms that are subject to overflow and often difficult to drain:					
Sloan silt loam, 0 to 3 percent slopes	Grain farming.	Corn, soybeans.	----------	Continuous row crop.	----------
Sloan silty clay loam, 0 to 3 percent slopes.					
ORGANIC					
Management group 7—Organic soils:					
Carlisle muck	Special crops.	Potatoes, onions, mint carrots, corn.	Small grain, alfalfa.	Continuous row crop.	----------
Edwards muck					
Linwood muck					

See footnotes at end of table.

for the soils of Carroll County, Indiana—(Continued)

OF UPLANDS AND TERRACES—(Continued)

crop rotations [2]			Lime needed on land not limed [4]	Fertilization [5]						Dominant management problems	Other soil management practices needed and remarks
With conservation practices				Average management (pounds per acre per year)			Superior management (pounds per acre per year)				
Contour tillage [3]	Strip-cropping	Terracing		N	P_2O_5	K_2O	N	P_2O_5	K_2O		
			Tons per acre								
----------	----------	----------	1–3	40 on corn, 20 on wheat.	20	25	60 on corn, 20 on wheat.	25	45	Drainage.	Provide tile or open-ditch drainage as needed.
OF UPLANDS AND TERRACES											
----------	----------	----------	0	20 on wheat.	20	20	40 on corn, 20 on wheat.	25	35	Drainage.	Provide tile drainage; plow clayey or "gumbo" areas in the fall.
----------	----------	----------	0	----------	20	25	40 on corn, 20 on wheat.	25	45	Drainage.	Maintain tile drainage system to prevent filling in from sandy substrata.
----------	----------	----------	0	----------	20	20	50 on corn.	30	30	Flooding and drainage.	Protect from overflow; drain by open ditches, or tile if outlet is available.
SOILS											
----------	----------	----------	0	----------	20	40	50 on corn.	30	60	Drainage.	Provide controlled tile-drainage to remove water in spring and to maintain water level during dry periods; these soils need potassium and after a few years of cultivation require phosphorus.

TABLE 6.—*Suggested use and management*

LIGHT-COLORED MINERAL SOILS

Management group and subgroup and soil type or phrase	Suitable use	Crops well suited [1]	Crops not suited	Suitable	
				Without conservation practices	
				Grain system	Livestock system
SOILS OF THE					
Management group 8—Bottom lands:					
Subgroup 8A—Well-drained soils:					
Ross loam, 0 to 3 percent slopes	Grain farming.	Corn, soybeans, alfalfa.	----------	RRG (Sc)	----------
Ross silt loam, 0 to 3 percent slopes					
Ross silty clay loam, 0 to 3 percent slopes.					
Genesee fine sandy loam, high bottom, 0 to 3 percent slopes.					
Genesee loam, high bottom, 0 to 3 percent slopes.					
Genesee silt loam, high bottom, 0 to 3 percent slopes.					
Genesee fine sandy loam, 0 to 3 percent slopes.	Grain farming.	Corn, soybeans.	Fall-seeded small grain.	Continuous row crop.	
Genesee loam, 0 to 3 percent slopes					
Genesee silt loam, 0 to 3 percent slopes.					
Subgroup 8B—Imperfectly drained to moderately well drained soils:					
Eel loam, 0 to 3 percent slopes	Grain farming or permanent pasture on small areas.	Corn, soybeans.	----------	Continuous row crop.	----------
Eel silt loam, 0 to 3 percent slopes					
Eel silty clay loam, 0 to 3 percent slopes.					

[1] Crops listed in this column have above average suitability for the particular soil or group of soils.

[2] R=row crop, corn or soybeans; G=small grain, chiefly oats and wheat; M=meadow, preferably mixed grass-and-legume meadow; (Sc)=intercrop of legume-grass mixture, usually including sweetclover, sown in a small grain and plowed down for the following year. The rotation listed in each column is the most intensive one suitable under the conditions indicated. Other rotations of equal or less intensity may be chosen from those in the list on page 18.

[3] Contour tillage is limited to slopes less than 200 feet long.

[4] Amount of ground limestone needed probably will be in the range indicated; test before liming. Limestone should be ground fine enough so that 40 percent or more will pass through

for location of soils in the county that have (1) very high, (2) high, (3) moderate, (4) low, and (5) very low resistance to drought.

Organic matter

Organic matter in the soil absorbs and holds moisture for plants, serves as a storage place for nitrogen, improves tilth, and increases resistance to erosion. Shortage of organic matter seriously limits the productivity of any soil. All the light-colored soils of the county, and particularly the light-colored, poorly drained, sandy and eroded soils, need more organic matter (see table 6).

A suitable crop rotation, properly fertilized, limed, and protected from erosion and overflow, is the basic means of maintaining organic matter. The legumes and grasses grown in the rotation replenish organic matter. They are soil-building crops, and, in each rotation, they should be on the soil long enough to offset the losses caused by growing corn or other soil-depleting crops. The rotation should be supported by other practices. All crop residues and manure should be returned to the soil and turned under. Manure should be protected from the weather. If it is not, rainfall leaches out much of the nitrogen and potassium before the manure is spread on the field. Cover crops should follow corn or other clean-tilled crops. Otherwise, the soil will erode. Erosion means loss of surface soil—the part of the soil that contains the most organic matter and plant nutrients.

The method of replenishing organic matter will depend on the kind of soil and the choice of the operator. If a soil is in reasonably good tilth, organic matter can be added by using nitrogen fertilizer. The heavy application of nitrogen increases plant growth, and the operator returns the extra growth to the soil either in the form of crop residues or manure. Heavy applications of nitrogen will thus allow use of soil-depleting crops during a greater proportion of the rotation.

But if a soil is in poor physical condition, or tilth, restoring organic matter by means of increased use of nitrogen fertilizer may not be practical. The poor tilth of the soil prevents plants from taking advantage

for the soils of Carroll County, Indiana—(Continued)

OF UPLANDS AND TERRACES—(Continued)

crop rotations [2]			Lime needed on land not limed [4]	Fertilization [5]						Dominant management problems	Other soil management practices needed and remarks
With conservation practices				Average management (pounds per acre per year)			Superior management (pounds per acre per year)				
Contour tillage [3]	Strip-cropping	Terracing		N	P_2O_5	K_2O	N	P_2O_5	K_2O		
BOTTOM LANDS											
----------	----------	----------	0	50 on corn.	20	20	80 on corn.	30	30	Flooding.	Protect larger areas by levees; retain timber strips along larger streams for bank protection; control weeds by using crop rotation and by spraying with 2–4, D.
----------	----------	----------	0	---------	20	20	40 on corn.	30	30	Flooding.	

a 60-mesh sieve. If coarse grades of limestone are applied, use 50 percent more. If legumes are to be seeded after liming and immediate results are wanted, double the rate of application.

[5] Fertilizer recommendations are based on pounds of nitrogen (N), available phosphorus (P_2O_5) and water-soluble potash (K_2O) per acre required annually for the rotations listed under the grain or livestock systems of farming. Rates under average management will maintain soil productivity. Rates under superior management are for soils testing medium or higher in phosphorus and potassium. If yields are low and soil tests indicate fertility is low, larger applications of phosphorus and potash may be made. See page 19 for sample calculation of a fertilizer program for a specified soil.

[6] Included in this group because the soil is shallow.

of the extra nitrogen. For these soils, deep-rooted legumes such as alfalfa and sweetclover are the best choice. The deep-reaching roots loosen the soil so air and water can penetrate, the bacteria living on the roots provide nitrogen, and the whole plant, when plowed under, adds organic matter. Normally, it is best to sow legumes in mixture with grasses. The grasses benefit from the nitrogen furnished by the legumes, the mixture of plants having different growth periods provides cover for a longer time each year, and the danger of losing the stand through frost heaving is reduced.

Estimated Yields and Productivity Ratings

Estimated yields

Table 7 gives estimated average acre yields of principal crops for each soil under common and improved practices. The estimates in columns A indicate yields obtained under prevailing practices. Under prevailing management, small to moderate quantities of commercial fertilizer are used, but careful control of erosion, incorporation of organic matter, and maintenance and increase of soil fertility and productivity normally are not practiced.

Yields under more careful and intensive practices are given in columns B. These practices are (1) regular use of a crop rotation that includes legumes wherever it is practical to grow them, (2) use of barnyard and green manures, (3) application of lime and liberal quantities of commercial fertilizer, (4) installation of artificial drainage where necessary, and (5) control of erosion by such practices as contour tillage, stripcropping, terracing, or construction of diversion ditches.

The estimates in table 7 are primarily based on (1) interviews with farmers, the county agent, and members of the Purdue University Agricultural Experiment Station; (2) on direct observations made by members of the soil survey party; and (3) on results obtained by the experiment station on experimental farms. The yields are estimates of average production over a period of years, according to the two broadly defined types of management. The yields may

TABLE 7.—*Estimated average acre yields of principal crops on each soil*

[Yields in columns A obtained under prevailing practices; those in columns B obtained with improved management, which includes use of crop rotations that include legumes, use of barnyard and green manures, application of lime and liberal quantities of commercial fertilizer, artificial drainage, and control of erosion by such practices as contour tillage, stripcropping, terracing, or construction of diversion ditches. Absence of a yield figure indicates that the crop is not commonly grown under the management level indicated]

Soil type or phase [1]	Corn		Wheat		Oats		Soybeans		Mixed hay		Clover		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Abington silty clay loam, 0 to 3 percent slopes:														
Drained	50	80	17	22	40	50	20	27	1.8	2.4	1.0	1.8	2.0	3.2
Undrained	20		8		15		12		1.6		.4			
Brookston silty clay loam, 0 to 3 percent slopes:														
Drained	55	80	22	32	40	65	22	32	1.8	2.5	1.8	2.0	3.0	4.0
Undrained	25		12		20		15		1.2		.6			
Carlisle muck:														
Drained	45	65					15	25	1.8	2.4				
Undrained									1.4					
Cope silt loam, 0 to 3 percent slopes:														
Drained	48	70	20	30	38	60	20	30	1.6	2.5	1.6	2.0	2.8	4.0
Undrained	25		12		22		15		1.4		.8			
Cope silty clay loam, 0 to 3 percent slopes:														
Drained	50	78	22	32	40	65	21	32	1.8	2.5	1.8	2.0	2.8	4.0
Undrained	25		12		20		15		1.2		.6			
Crosby silt loam, 0 to 3 percent slopes:														
Drained	38	65	20	32	35	60	20	30	1.4	2.0	1.6	2.4	2.4	3.6
Undrained	25		12		25		19		1.3		1.0		1.6	
Edwards muck:														
Drained	30	50					14	22	1.4	2.0				
Undrained									1.2					
Eel loam, 0 to 3 percent slopes:														
Protected	55	65	15	20	35	50	25	27	2.2	2.5	1.5	2.0	2.4	3.0
Unprotected	45		8		25		22		2.0		.5			
Eel silt loam, 0 to 3 percent slopes:														
Protected	55	70	15	20	40	50	25	28	2.2	2.5	1.5	2.0	2.4	3.0
Unprotected	45		8		15		22		2.0		.5			
Eel silty clay loam, 0 to 3 percent slopes:														
Protected	65	70	15	20	40	50	22	30	2.2	2.5	1.5	1.8	2.4	3.0
Unprotected	30						20		2.0					
Farmington silt loam, 0 to 4 percent slopes	20	30	12	17	20	30	12	15	.7	1.0	.6	.8	2.5	3.4
Fincastle silt loam, 0 to 3 percent slopes:														
Drained	40	67	19	32	35	60	20	30	1.4	2.4	1.4	2.4	2.4	3.5
Undrained	22		10		20		10		1.2		1.0		1.2	
Fox fine sandy loam, 0 to 3 percent slopes	28	40	13	17	15	20	13	17	.6	1.0	.4	.8	1.2	2.4
Fox loam, 0 to 3 percent slopes	32	43	19	30	25	40	19	30	.9	1.3	.8	1.2	1.6	2.8
Fox loam, 3 to 8 percent slopes	30	40	19	30	23	40	19	28	.9	1.3	.8	1.2	1.6	2.8
Fox loam, 3 to 8 percent slopes, eroded	20	30	14	20	18	25	14	22	.6	1.2	.5	1.0	1.4	2.6
Fox loam, 8 to 12 percent slopes	20	30	10	15	15	25	10	15	.6	1.2	.6	1.0	1.2	2.4
Fox loam, 8 to 12 percent slopes, eroded	15	25	8	12	13	20	10	14	.5	1.0	.4	.8	1.0	2.2
Fox loam, 3 to 8 percent slopes, eroded kame phase	30	40	15	20	20	30	12	18	.8	1.3	.6	1.2	2.0	3.0
Fox loam, 8 to 25 percent slopes, eroded kame phase	15	25	5	10					.5	.8			1.4	2.0
Fox loam and clay loam, 8 to 12 percent slopes, severely eroded	10	18	4	8	10	15			.4	.8			.8	1.6
Fox loam and clay loam, 12 to 25 percent slopes, severely eroded			5	8					.2	.5			.5	1.5
Fox silt loam, 0 to 3 percent slopes	35	48	20	30	25	45	20	30	1.2	1.6	1.0	1.4	2.0	3.2
Fox silt loam, 3 to 8 percent slopes	32	45	19	30	23	40	19	30	1.2	1.6	1.0	1.4	2.0	3.2
Fox loam, 12 to 25 percent slopes	12	20	6	10	12	17	6	10	.5	1.0	.4	.6	.9	2.0
Fox loam, 12 to 25 percent slopes, eroded	10	15	8	12	10	15	5	8	.3	.7			.7	1.8
Genesee fine sandy loam, 0 to 3 percent slopes:														
Protected	38	45	20	25	35	40	18	22	1.3	1.7	1.0	1.4	3.0	3.6
Unprotected	35	45	13	18	15	30	18	22	1.3	1.7	.8	1.2	2.8	3.2
Genesee fine sandy loam, high bottom, 0 to 3 percent slopes	33	50	15	20	30	38	17	22	1.3	1.8	.8	1.2	2.4	3.2

See footnote at end of table.

TABLE 7.—*Estimated average acre yields of principal crops on each soil*—Continued

Soil type or phase [1]	Corn		Wheat		Oats		Soybeans		Mixed hay		Clover		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Genesee loam, 0 to 3 percent slopes:														
Protected	55	70	25	28	40	50	22	28	1.8	2.3	2.0	2.4	3.6	4.0
Unprotected	50	65	14	20	20	35	22	28	1.8	2.3	1.6	2.0	3.0	3.6
Genesee loam, high bottom, 0 to 3 percent slopes	45	60	20	25	35	50	20	28	1.8	2.2	1.5	2.2	3.0	4.0
Genesee silt loam, 0 to 3 percent slopes:														
Protected	60	75	25	28	40	50	25	34	2.0	2.5	2.0	2.4	4.0	4.4
Unprotected	55	70	12	16	20	25	25	34	2.0	2.5	1.3	1.5	2.5	3.0
Genesee silt loam, high bottom, 0 to 3 percent slopes	50	65	20	25	30	45	20	30	2.2	2.5	1.5	2.2	3.2	4.0
Hennepin loam, 25 to 65 percent slopes	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Homer silt loam, 0 to 3 percent slopes:														
Drained	35	50	15	22	30	45	15	25	1.5	2.0	1.4	1.8	2.0	3.2
Undrained	25	-----	12	-----	25	-----	14	-----	1.3	-----	.8	-----	-----	-----
Kokomo silty clay loam, 0 to 3 percent slopes:														
Drained	45	65	15	20	35	50	15	25	1.8	2.5	1.0	1.5	2.0	3.2
Undrained	20	-----	8	-----	15	-----	12	-----	1.0	-----	.4	-----	-----	-----
Linwood muck:														
Drained	45	60	-----	-----	-----	-----	15	25	1.8	2.4	-----	-----	-----	-----
Undrained	-----	-----	-----	-----	-----	-----	-----	-----	1.4	-----	-----	-----	-----	-----
Longlois silt loam, 0 to 3 percent slopes	40	65	20	32	33	47	20	32	1.4	2.0	1.4	2.0	2.8	3.6
Lyles loam, 0 to 3 percent slopes:														
Drained	40	55	17	22	30	50	18	25	1.5	2.0	1.3	1.5	2.0	3.0
Undrained	15	-----	8	-----	20	-----	12	-----	1.2	-----	-----	-----	-----	-----
Metea fine sandy loam, 3 to 8 percent slopes	25	40	10	20	18	35	10	17	.6	1.5	-----	-----	2.0	3.2
Miami silt loam, 3 to 8 percent slopes	40	65	20	30	35	55	20	27	1.4	2.0	1.2	1.9	2.5	3.8
Miami silt loam, 3 to 8 percent slopes, eroded	30	45	15	22	25	35	20	26	1.0	1.6	1.0	1.6	2.0	3.4
Miami silt loam, 8 to 12 percent slopes, eroded	20	35	11	16	20	30	11	16	.8	1.2	.7	1.1	1.6	2.4
Miami silt loam, 12 to 18 percent slopes, eroded	15	23	8	12	15	23	-----	-----	.6	1.0	.4	.8	1.0	2.0
Millsdale silty clay loam, 0 to 3 percent slopes:														
Drained	50	65	15	20	30	55	20	27	1.5	2.0	1.2	1.5	2.0	3.0
Undrained	20	-----	8	-----	20	-----	10	-----	1.0	-----	-----	-----	-----	-----
Milton silt loam, 0 to 5 percent slopes	35	50	18	25	30	40	18	25	1.2	1.8	1.0	1.5	2.2	2.7
Monitor silt loam, 0 to 3 percent slopes:														
Drained	43	70	20	30	35	50	20	30	1.5	2.2	1.4	2.0	2.2	3.4
Undrained	25	-----	12	-----	25	-----	18	-----	1.3	-----	.7	-----	-----	-----
Nineveh loam, 0 to 3 percent slopes	28	35	18	28	22	40	18	28	.8	1.3	.7	1.0	2.0	2.8
Oaktown loamy fine sand, 3 to 10 percent slopes	22	30	10	15	10	15	10	15	.4	.8	-----	-----	1.6	2.8
Ockley loam, 0 to 3 percent slopes	35	45	18	30	28	45	18	30	1.2	1.8	1.0	1.6	2.2	3.4
Ockley loam, 3 to 8 percent slopes	35	45	18	30	28	45	18	30	1.1	1.7	1.0	1.6	2.2	3.4
Ockley loam, 3 to 8 percent slopes, eroded	22	38	15	25	22	40	15	25	1.0	1.6	.8	1.3	1.8	3.0
Ockley silt loam, 0 to 3 percent slopes	40	55	20	32	30	50	20	32	1.3	2.0	1.3	1.8	2.4	3.6
Ockley silt loam, 3 to 8 percent slopes	38	50	20	32	30	50	20	32	1.2	1.9	1.3	1.8	2.4	3.6
Ockley silt loam, 3 to 8 percent slopes, eroded	30	45	16	25	25	40	16	25	1.0	1.6	1.0	1.5	2.0	3.2
Rodman gravelly loam, 25 to 60 percent slopes	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Ross loam, 0 to 3 percent slopes	40	60	18	22	30	40	22	30	1.8	2.2	1.6	2.0	2.8	3.5
Ross silt loam, 0 to 3 percent slopes	48	60	22	30	40	55	25	30	1.8	2.5	2.0	2.5	2.8	3.8
Ross silty clay loam, 0 to 3 percent slopes	50	65	20	28	35	50	25	38	1.8	2.4	1.8	2.2	2.8	3.6
Russell silt loam, 0 to 3 percent slopes	40	65	20	32	35	60	20	33	1.5	2.1	1.5	2.0	2.3	3.8
Russell silt loam, 3 to 8 percent slopes	38	60	20	32	35	55	19	32	1.4	2.0	1.2	1.8	2.2	3.6
Russell silt loam, 3 to 8 percent slopes, eroded	32	45	14	20	25	40	15	20	1.1	1.6	.9	1.4	1.8	3.0
Russell silt loam, 8 to 12 percent slopes	27	40	14	22	25	37	15	22	1.0	1.5	.8	1.3	1.8	3.2
Russell silt loam, 8 to 12 percent slopes, eroded	20	30	12	16	20	30	12	17	.8	1.1	.7	.9	1.5	2.4
Russell silt loam, 12 to 25 percent slopes	20	27	10	15	17	25	-----	-----	.8	1.2	.6	1.0	1.4	2.4
Russell silt loam, 12 to 25 percent slopes, eroded	15	22	8	12	15	22	-----	-----	.6	1.0	.4	.8	1.0	2.0

See footnote at end of table.

TABLE 7.—*Estimated average acre yields of principal crops on each soil*—Continued

Soil type or phase [1]	Corn		Wheat		Oats		Soybeans		Mixed hay		Clover		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded	25	37	10	14	20	30	10	14	.8	1.1	.5	.8	1.3	2.5
Russell silt loam and silty clay loam, 8 to 12 percent slopes, severely eroded	15	22	8	12	15	25	7	12	.6	.8	.3	.6	1.0	2.0
Russell silt loam and silty clay loam, 12 to 25 percent slopes, severely eroded	12	20	7	10	10	20	-----	-----	.5	.8	.3	.5	.8	1.7
Sleeth silt loam, 0 to 3 percent slopes:														
Drained	35	55	15	22	30	45	15	25	1.5	2.0	1.4	1.8	2.0	3.2
Undrained	25	-----	12	-----	25	-----	14	-----	1.3	-----	.8	-----	-----	-----
Sloan silt loam, 0 to 3 percent slopes:														
Drained	45	70	13	22	30	50	20	27	1.8	2.5	1.0	1.7	2.4	3.5
Undrained	25	-----	-----	-----	15	-----	19	-----	1.6	-----	-----	-----	-----	-----
Sloan silty clay loam, 0 to 3 percent slopes:														
Drained	45	70	10	20	30	50	20	30	1.8	2.5	1.0	1.7	2.4	3.5
Undrained	25	-----	-----	-----	15	-----	19	-----	1.6	-----	-----	-----	-----	-----
Washtenaw silt loam, 0 to 3 percent slopes:														
Drained	45	70	15	25	35	50	17	27	1.8	2.2	1.4	1.8	2.0	2.8
Undrained	35	-----	10	-----	25	-----	15	-----	1.7	-----	.6	-----	-----	-----
Westland loam, 0 to 3 percent slopes:														
Drained	45	55	16	27	35	55	18	27	1.6	2.2	1.3	2.2	2.8	4.2
Undrained	25	-----	16	-----	20	-----	16	-----	1.4	-----	1.1	-----	1.6	-----
Westland silt loam, 0 to 3 percent slopes:														
Drained	50	80	20	30	40	60	20	30	1.8	2.5	1.5	2.5	3.0	4.4
Undrained	30	-----	10	-----	20	-----	17	-----	1.5	-----	1.0	-----	-----	-----
Westland silty clay loam, 0 to 3 percent slopes:														
Drained	57	87	22	30	40	60	22	30	1.8	2.5	1.5	2.5	3.0	4.4
Undrained	30	-----	8	-----	20	-----	19	-----	1.5	-----	.8	-----	-----	-----

[1] The terms "drained" and "undrained" refer to artificial drainage, and "protected" and "unprotected" to the presence or absence of levees.

not apply directly to any specific tract of land in any particular year, because management differs slightly from farm to farm and because climate fluctuates. Nevertheless, the estimates are as accurate as can be obtained without further detailed and lengthy investigation. Their main value is that they serve to bring out the relative productivity of the soils, and the responsiveness of the soils to good management practices.

Productivity ratings

In table 8 the soils are rated according to their general productivity. Each rating denotes the productivity of the soil for a particular crop in relation to a standard index of 100. The standard index represents the average acre yield obtained, without use of amendments, on the more extensive and better soil types in the regions of the United States where the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as a soil with the standard index of 100. The average acre yield upon which the standard index is based is given at the head of each column. Productivity indexes may be more than 100 for some soils that have high natural fertility or that have been improved by heavy fertilization and other intensive management.

Crop productivity indexes cannot be used alone as a measure of land value. Costs of production, distance to market, relative prices for farm products, and other factors influence the value of land. Productivity, as measured by yields, is not the only thing that affects the worth of a soil for a crop. Ease or difficulty of maintaining tilth and productivity, for example, influence the general desirability of a soil for agriculture.

TABLE 8.—*Productivity ratings for the soils at two levels of management*

[Productivity ratings in this table are the expected yields of table 7 expressed as a percentage of the standard yield. The standard, shown at the head of this table for each crop, is the average yield, obtained without use of amendments, on the more extensive and better soil types in those regions of the United States where that crop is most widely grown. In columns A are ratings expected under prevailing management, and in columns B are ratings expected under improved management]

Management group or subgroup and soil type or phase [1]	Corn for grain (100= 50 bu.)		Wheat (100= 25 bu.)		Oats (100= 50 bu.)		Soybeans (100= 25 bu.)		Mixed hay (100= 2 tons)		Red Clover (100= 2 tons)		Alfalfa (100= 4 tons)		Pasture (100=100 cow-acre-days) [2]	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Management subgroup 1A:																
Russell silt loam, 0 to 3 percent slopes	80	130	80	130	70	120	80	130	75	105	75	100	60	95	70	80
Russell silt loam, 3 to 8 percent slopes	75	120	80	130	70	110	75	130	70	100	60	90	55	90	70	80
Miami silt loam, 3 to 8 percent slopes	80	130	80	120	70	110	80	110	70	100	60	95	60	95	70	85
Milton silt loam, 0 to 5 percent slopes	70	95	70	100	60	80	70	100	60	90	50	75	55	70	50	60
Management subgroup 1B:																
Miami silt loam, 3 to 8 percent slopes, eroded	60	90	60	90	50	70	80	105	50	80	50	80	50	85	50	60
Russell silt loam, 3 to 8 percent slopes, eroded	65	90	55	100	50	80	60	100	55	80	45	70	45	75	50	60
Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded	50	75	40	55	40	60	40	55	40	55	25	40	30	60	30	50
Management subgroup 1C:																
Russell silt loam, 8 to 12 percent slopes	55	80	55	90	50	75	60	90	50	75	40	65	45	80	60	70
Russell silt loam, 8 to 12 percent slopes, eroded	40	60	50	65	40	60	50	70	40	55	35	45	40	60	50	60
Miami silt loam, 8 to 12 percent slopes, eroded	40	70	45	65	40	60	45	65	40	60	35	55	40	60	50	60
Management subgroup 1D:																
Russell silt loam and silty clay loam, 8 to 12 percent slopes, severely eroded	30	45	30	50	30	50	30	50	30	40	15	30	25	50	30	50
Russell silt loam, 12 to 25 percent slopes	40	55	40	60	35	50	-----	-----	40	60	30	50	35	60	50	60
Russell silt loam, 12 to 25 percent slopes, eroded	30	45	30	50	30	45	-----	-----	30	50	20	40	25	50	40	50
Russell silt loam and silty clay loam, 12 to 25 percent slopes, severely eroded	25	40	30	40	20	40	-----	-----	25	40	15	25	20	40	20	40
Miami silt loam, 12 to 18 percent slopes, eroded	30	45	30	50	30	45	-----	-----	30	50	20	40	25	50	40	50
Management subgroup 1E:																
Hennepin loam, 25 to 65 percent slopes	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	40
Rodman gravelly loam, 25 to 60 percent slopes	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20	-----
Farmington silt loam, 0 to 4 percent slopes	40	60	50	70	40	60	50	60	35	50	30	40	60	85	65	-----
Management subgroup 2A:																
Longlois silt loam, 0 to 3 percent slopes	80	130	80	130	65	95	80	130	70	100	70	100	70	90	70	80
Ockley silt loam, 0 to 3 percent slopes	80	110	80	130	60	100	80	130	65	100	65	90	60	90	70	80
Ockley loam, 0 to 3 percent slopes	70	90	70	130	55	90	70	120	60	90	50	80	55	85	50	60
Fox silt loam, 0 to 3 percent slopes	70	95	80	120	50	90	80	120	60	80	50	70	50	80	70	80
Fox loam, 0 to 3 percent slopes	65	85	80	120	50	80	80	120	45	65	40	60	40	70	50	60

See footnote at end of table.

TABLE 8.—*Productivity ratings for the soils at two levels of management—Continued*

Management group or subgroup and soil type or phase [1]	Corn for grain (100= 50 bu.)		Wheat (100= 25 bu.)		Oats (100= 50 bu.)		Soybeans (100= 25 bu.)		Mixed hay (100= 2 tons)		Red Clover (100= 2 tons)		Alfalfa (100= 4 tons)		Pasture (100=100 cow-acre-days) [2]	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Nineveh loam, 0 to 3 percent slopes	55	70	70	110	45	80	70	110	40	65	35	50	50	70	40	50
Management subgroup 2B:																
Ockley silt loam, 3 to 8 percent slopes	75	100	80	130	60	100	80	130	60	95	65	90	60	90	70	80
Ockley loam, 3 to 8 percent slopes	70	90	70	130	55	90	60	120	55	85	50	80	55	85	50	60
Fox silt loam, 3 to 8 percent slopes	65	90	80	120	45	80	75	120	60	80	50	70	50	80	70	80
Fox loam, 3 to 8 percent slopes	60	80	80	120	45	80	80	115	45	65	40	60	40	70	50	60
Management subgroup 2C:																
Ockley silt loam, 3 to 8 percent slopes, eroded	60	90	65	100	50	80	65	100	50	80	50	75	50	80	50	60
Ockley loam, 3 to 8 percent slopes, eroded	45	75	60	100	45	80	60	100	50	80	40	65	45	75	40	50
Fox loam, 3 to 8 percent slopes, eroded	40	60	55	80	35	50	55	90	30	60	25	50	35	65	40	50
Fox loam, 3 to 8 percent slopes, eroded kame phase	60	80	60	80	40	60	50	70	40	65	30	60	50	75	40	50
Management subgroup 2D:																
Fox loam, 8 to 12 percent slopes	40	60	40	60	30	50	40	60	30	60	30	50	30	60	40	50
Fox loam, 8 to 12 percent slopes, eroded	30	50	30	50	25	40	40	55	25	50	20	40	25	55	30	40
Fox loam, 8 to 25 percent slopes, eroded kame phase	30	50	20	40	-----	-----	-----	-----	25	40	-----	-----	35	50	30	50
Management subgroup 2E:																
Fox loam and clay loam, 8 to 12 percent slopes, severely eroded	20	35	15	30	20	30	-----	-----	20	40	-----	-----	20	40	20	30
Fox loam, 12 to 25 percent slopes	25	40	25	40	25	35	25	40	25	50	20	30	25	50	30	40
Fox loam, 12 to 25 percent slopes, eroded	20	30	30	50	20	30	20	30	15	35	-----	-----	20	45	20	30
Fox loam and clay loam, 12 to 25 percent slopes, severely eroded	-----	-----	20	30	-----	-----	-----	-----	10	25	-----	-----	10	40	10	20
Management group 3:																
Metea fine sandy loam, 3 to 8 percent slopes	50	80	40	80	35	70	40	70	30	75	-----	-----	50	80	20	40
Fox fine sandy loam, 0 to 3 percent slopes	55	80	50	70	30	40	50	70	30	50	20	40	30	60	30	40
Management group 4:																
Oaktown loamy fine sand, 3 to 10 percent slopes	45	60	40	60	20	30	40	60	20	40	-----	-----	40	70	20	30
Management group 5:																
Crosby silt loam, 0 to 3 percent slopes:																
Drained	75	130	80	130	70	120	80	120	70	100	70	120	60	90	70	80
Undrained	50	-----	50	-----	50	-----	75	-----	65	-----	50	-----	40	-----	60	-----
Fincastle silt loam, 0 to 3 percent slopes:																
Drained	80	135	80	130	70	120	80	120	70	120	70	120	60	85	70	80
Undrained	45	-----	40	-----	40	-----	40	-----	60	-----	50	-----	30	-----	60	-----
Monitor silt loam, 0 to 3 percent slopes:																
Drained	85	140	80	120	70	100	80	120	75	110	70	100	55	85	70	80
Undrained	50	-----	50	-----	50	-----	70	-----	65	-----	45	-----	-----	-----	60	-----
Sleeth silt loam, 0 to 3 percent slopes:																
Drained	70	110	60	90	60	90	60	100	75	100	70	90	50	80	70	80
Undrained	50	-----	50	-----	50	-----	55	-----	65	-----	40	-----	-----	-----	-----	-----

See footnote at end of table.

TABLE 8.—*Productivity ratings for the soils at two levels of management—Continued*

Management group or subgroup and soil type or phase [1]	Corn for grain (100= 50 bu.)		Wheat (100= 25 bu.)		Oats (100= 50 bu.)		Soybeans (100= 25 bu.)		Mixed hay (100= 2 tons)		Red Clover (100= 2 tons)		Alfalfa (100= 4 tons)		Pasture (100=100 cow-acre-days) [2]	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Homer silt loam, 0 to 3 percent slopes:																
Drained	70	100	60	90	60	90	60	100	75	100	70	90	50	80	70	80
Undrained	50	-----	50	-----	50	-----	55	-----	65	-----	40	-----	-----	-----	-----	-----
Management subgroup 6A:																
Brookston silty clay loam, 0 to 3 percent slopes:																
Drained	110	160	90	130	80	130	90	130	90	125	90	100	75	100	80	100
Undrained	50	-----	50	-----	40	-----	60	-----	60	-----	30	-----	-----	-----	60	-----
Cope silt loam, 0 to 3 percent slopes:																
Drained	95	140	80	120	75	120	80	120	80	125	80	100	70	100	75	100
Undrained	50	-----	50	-----	45	-----	60	-----	70	-----	40	-----	-----	-----	60	-----
Cope silty clay loam, 0 to 3 percent slopes:																
Drained	100	150	90	130	80	130	85	130	90	125	90	100	70	100	80	100
Undrained	50	-----	50	-----	40	-----	60	-----	60	-----	30	-----	-----	-----	60	-----
Kokomo silty clay loam, 0 to 3 percent slopes:																
Drained	90	130	60	80	70	100	60	100	90	125	50	75	50	80	70	100
Undrained	40	-----	30	-----	30	-----	50	-----	50	-----	20	-----	-----	-----	40	-----
Millsdale silty clay loam, 0 to 3 percent slopes:																
Drained	100	130	60	80	60	110	80	110	75	100	60	75	50	75	80	90
Undrained	40	-----	30	-----	40	-----	40	-----	50	-----	-----	-----	-----	-----	-----	-----
Washtenaw silt loam, 0 to 3 percent slopes:																
Drained	90	140	60	100	70	100	70	110	90	110	70	90	50	70	70	80
Undrained	70	-----	40	-----	50	-----	60	-----	85	-----	30	-----	-----	-----	-----	-----
Management subgroup 6B:																
Abington silty clay loam, 0 to 3 percent slopes:																
Drained	100	160	70	90	80	100	80	110	90	120	50	90	50	80	85	100
Undrained	40	-----	30	-----	30	-----	50	-----	80	-----	20	-----	-----	-----	-----	-----
Lyles loam, 0 to 3 percent slopes:																
Drained	80	110	70	90	60	100	70	100	75	100	65	75	50	75	70	80
Undrained	30	-----	30	-----	40	-----	50	-----	60	-----	-----	-----	-----	-----	-----	-----
Westland loam, 0 to 3 percent slopes:																
Drained	90	110	75	110	70	110	75	110	80	110	65	110	70	105	80	90
Undrained	50	-----	55	-----	40	-----	65	-----	70	-----	55	-----	40	-----	-----	-----
Westland silt loam, 0 to 3 percent slopes:																
Drained	100	160	80	120	80	120	80	120	90	125	75	125	75	110	80	100
Undrained	60	-----	40	-----	40	-----	70	-----	75	-----	50	-----	-----	-----	-----	-----
Westland silty clay loam, 0 to 3 percent slopes:																
Drained	115	175	90	120	80	120	90	120	90	125	75	125	75	110	80	100
Undrained	60	-----	30	-----	40	-----	75	-----	75	-----	40	-----	-----	-----	-----	-----
Management subgroup 6C:																
Sloan silt loam, 0 to 3 percent slopes:																
Drained	90	140	50	90	60	100	80	110	90	125	50	85	60	90	80	90
Undrained	50	-----	-----	-----	30	-----	75	-----	80	-----	-----	-----	-----	-----	-----	-----
Sloan silty clay loam. 0 to 3 percent slopes:																
Drained	90	140	40	80	60	100	80	120	90	125	50	85	60	90	80	90
Undrained	50	-----	-----	-----	30	-----	75	-----	80	-----	-----	-----	-----	-----	-----	-----
Management group 7:																
Carlisle muck:																
Drained	90	130	-----	-----	-----	-----	60	100	90	120	-----	-----	-----	-----	110	-----
Undrained	-----	-----	-----	-----	-----	-----	-----	-----	70	-----	-----	-----	-----	-----	-----	-----

See footnote at end of table.

TABLE 8.—*Productivity ratings for the soils at two levels of management—Continued*

Management group or subgroup and soil type or phase [1]	Corn for grain (100= 50 bu.)		Wheat (100= 25 bu.)		Oats (100= 50 bu.)		Soybeans (100= 25 bu.)		Mixed hay (100= 2 tons)		Red Clover (100= 2 tons)		Alfalfa (100= 4 tons)		Pasture (100=100 cow-acre-days) [2]	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Edwards muck:																
Drained	60	100	-----	-----	-----	-----	55	90	70	100	-----	-----	-----	-----	100	-----
Undrained	-----	-----	-----	-----	-----	-----	-----	-----	60	-----	-----	-----	-----	-----	-----	-----
Linwood muck:																
Drained	90	120	-----	-----	-----	-----	60	100	90	120	-----	-----	-----	-----	110	-----
Undrained	-----	-----	-----	-----	-----	-----	-----	-----	70	-----	-----	-----	-----	-----	-----	-----
Management subgroup 8A:																
Ross loam, 0 to 3 percent slopes	80	120	70	90	60	80	90	120	90	110	80	100	70	90	70	80
Ross silt loam, 0 to 3 percent slopes	95	120	90	120	80	110	100	120	90	125	100	125	70	95	80	90
Ross silty clay loam, 0 to 3 percent slopes	100	130	80	115	70	100	100	150	90	120	90	110	70	90	80	90
Genesee fine sandy loam, high bottom, 0 to 3 percent slopes	65	100	60	80	60	75	70	90	65	90	40	60	60	80	40	50
Genesee loam, high bottom, 0 to 3 percent slopes	90	120	80	100	70	100	80	115	90	110	75	110	75	100	80	50
Genesee silt loam, high bottom, 0 to 3 percent slopes	100	130	80	100	60	90	80	120	110	125	75	110	80	100	90	100
Genesee fine sandy loam, 0 to 3 percent slopes:																
Protected	75	90	80	100	70	80	70	90	65	85	50	70	75	90	-----	-----
Unprotected	70	90	50	70	30	60	70	90	65	85	40	60	70	80	40	50
Genesee loam, 0 to 3 percent slopes:																
Protected	110	140	100	110	80	100	90	110	90	115	100	120	90	100	-----	-----
Unprotected	100	130	55	80	40	70	90	110	90	115	80	100	75	90	80	90
Genesee silt loam, 0 to 3 percent slopes:																
Protected	120	150	100	110	80	100	100	135	100	125	100	120	100	110	-----	-----
Unprotected	110	140	50	65	40	50	100	135	100	125	65	75	65	75	90	100
Management subgroup 8B:																
Eel loam, 0 to 3 percent slopes:																
Protected	110	130	60	80	70	100	100	110	110	125	75	100	60	75	70	80
Unprotected	90	-----	30	-----	50	-----	90	-----	100	-----	25	-----	-----	-----	-----	-----
Eel silt loam, 0 to 3 percent slopes:																
Protected	110	140	60	80	80	100	100	115	110	125	75	100	60	75	-----	100
Unprotected and undrained.	90	-----	30	-----	30	-----	90	-----	100	-----	25	-----	-----	-----	90	-----
Eel silty clay loam, 0 to 3 percent slopes:																
Protected and drained	130	140	60	80	80	100	90	120	110	125	75	90	60	75	-----	90
Unprotected and undrained	60	-----	-----	-----	-----	-----	80	-----	100	-----	-----	-----	-----	-----	80	-----

[1] The terms "drained" and "undrained" refer to presence or absence of artificial drainage, and the terms "protected" and "unprotected" refer to the presence or absence of levees. Unprotected land is subject to overflow during the growing season; protected land is seldom overflowed but is sometimes covered by backwaters.

[2] Cow-acre-days is the number of days a mature animal (cow, steer, or horse) can graze 1 acre without injury to the pasture.

Soil Series, Types, and Phases

In the following pages the soil types and phases, identified by the same symbols as those used on the soil maps, are described in detail and their agricultural relations are discussed. The soils are arranged alphabetically by series name, and descriptions are given for each soil series containing more than one mapping unit; that is more than one soil type or phase. Where a series contains but one mapping unit, only that unit is described, and it is to be considered typical of its series. Some of the terms or word combinations used in describing soils are given in the section Soil Survey Methods and Definitions.

In the discussions of use and management for each soil, yield ranges and suggestions on amounts and mixtures of fertilizers are omitted, unless they are specifically related to drainage or soil characteristics. Information about fertilizers and yields are given in the section Nature of the Soils, Suggested Management, and Estimated Yields. The management group or subgroup in which each soil is placed follows the name of the soil. The location and distribution of each soil or miscellaneous land type is shown on the accompanying maps, and the approximate acreage and proportionate extent are given in table 9.

TABLE 9.—*Approximate acreage and proportionate extent of soils mapped*

Soil	Acres	Percent	Soil	Acres	Percent
Abington silty clay loam, 0 to 3 percent slopes	813	0.3	Miami silt loam, 3 to 8 percent slopes, eroded	332	0.1
Brookston silty clay loam, 0 to 3 percent slopes	12,892	5.4	Miami silt loam, 8 to 12 percent slopes, eroded	227	.1
Carlisle muck	1,353	.6	Miami silt loam, 12 to 18 percent slopes, eroded	98	(1)
Cope silt loam, 0 to 3 percent slopes	30,205	12.6	Millsdale silty clay loam, 0 to 3 percent slopes	290	.1
Cope silty clay loam, 0 to 3 percent slopes	4,328	1.8	Milton silt loam, 0 to 5 percent slopes	393	.2
Crosby silt loam, 0 to 3 percent slopes	1,578	.7	Monitor silt loam, 0 to 3 percent slopes	85	(1)
Edwards muck	104	(1)	Nineveh loam, 0 to 3 percent slopes	361	.2
Eel loam, 0 to 3 percent slopes	307	.1	Oaktown loamy fine sand, 3 to 10 percent slopes	1,021	.4
Eel silt loam, 0 to 3 percent slopes	4,974	2.1	Ockley loam, 0 to 3 percent slopes	896	.4
Eel silty clay loam, 0 to 3 percent slopes	844	.4	Ockley loam, 3 to 8 percent slopes	600	.3
Farmington silt loam, 0 to 4 percent slopes	894	.4	Ockley loam, 3 to 8 percent slopes, eroded	244	.1
Fincastle silt loam, 0 to 3 percent slopes	52,442	21.9	Ockley silt loam, 0 to 3 percent slopes	26,740	11.2
Fox fine sandy loam, 0 to 3 percent slopes	356	.1	Ockley silt loam, 3 to 8 percent slopes	5,081	2.1
Fox loam, 0 to 3 percent slopes	1,324	.6	Ockley silt loam, 3 to 8 percent slopes, eroded	3,466	1.5
Fox loam, 3 to 8 percent slopes	358	.1	Rodman gravelly loam, 25 to 60 percent slopes	1,539	.6
Fox loam, 3 to 8 percent slopes, eroded	458	.2	Ross loam, 0 to 3 percent slopes	180	.1
Fox loam, 8 to 12 percent slopes	902	.4	Ross silt loam, 0 to 3 percent slopes	358	.1
Fox loam, 8 to 12 percent slopes, eroded	610	.3	Ross silty clay loam, 0 to 3 percent slopes	569	.2
Fox loam, 3 to 8 percent slopes, eroded kame phase	251	.1	Russell silt loam, 0 to 3 percent slopes	1,021	.4
Fox loam, 8 to 25 percent slopes, eroded kame phase	175	.1	Russell silt loam, 3 to 8 percent slopes	19,113	8.0
Fox loam and clay loam, 8 to 12 percent slopes, severely eroded	826	.3	Russell silt loam, 3 to 8 percent slopes, eroded	6,133	2.6
Fox loam and clay loam, 12 to 25 percent slopes, severely eroded	149	.1	Russell silt loam, 8 to 12 percent slopes	1,519	.6
Fox silt loam, 0 to 3 percent slopes	3,235	1.4	Russell silt loam, 8 to 12 percent slopes, eroded	1,280	.5
Fox silt loam, 3 to 8 percent slopes	513	.2	Russell silt loam, 12 to 25 percent slopes	1,295	.5
Fox loam, 12 to 25 percent slopes	1,193	.5	Russell silt loam, 12 to 25 percent slopes, eroded	141	.1
Fox loam, 12 to 25 percent slopes, eroded	311	.1	Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded	916	.4
Genesee fine sandy loam, 0 to 3 percent slopes	450	.2	Russell silt loam and silty clay loam, 8 to 12 percent slopes, severely eroded	2,179	.9
Genesee fine sandy loam, high bottom, 0 to 3 percent slopes	185	.1	Russell silt loam and silty clay loam, 12 to 25 percent slopes, severely eroded	368	.2
Genesee loam, 0 to 3 percent slopes	1,723	.7	Sleeth silt loam, 0 to 3 percent slopes	7,582	3.2
Genesee loam, high bottom, 0 to 3 percent slopes	290	.1	Sloan silt loam, 0 to 3 percent slopes	286	.1
Genesee silt loam, 0 to 3 percent slopes	7,733	3.2	Sloan silty clay loam, 0 to 3 percent slopes	480	.2
Genesee silt loam, high bottom, 0 to 3 percent slopes	717	.3	Washtenaw silt loam, 0 to 3 percent slopes	458	.2
Gravel pits	137	.1	Westland loam, 0 to 3 percent slopes	36	(1)
Hennepin loam, 25 to 65 percent slopes	1,615	.7	Westland silt loam, 0 to 3 percent slopes	980	.4
Homer silt loam, 0 to 3 percent slopes	135	.1	Westland silty clay loam, 0 to 3 percent slopes	12,514	5.2
Kokomo silty clay loam, 0 to 3 percent slopes	497	.2	Water	2,964	1.2
Linwood muck	348	.1			
Longlois silt loam, 0 to 3 percent slopes	847	.4	Total	239,360	100.0
Lyles loam, 0 to 3 percent slopes	147	.1			
Metea fine sandy loam, 3 to 8 percent slopes	95	(1)			
Miami silt loam, 3 to 8 percent slopes	1,301	.5			

[1] Less than 0.1 percent.

Abington Series

Abington silty clay loam, 0 to 3 percent slopes (Aa) (management subgroup 6B).—This dark-colored very poorly drained soil has developed in swales and old glacial drainage channels, principally in the deeper depressions and around a few deeper areas of muck. It is the very poorly drained member of two catenas [4], Westland and the Longlois catena which also includes the Ockley catena which also includes the Sleeth and the Monitor and Westland. It is also associated with the Fox, Nineveh, and Homer soils. In most areas open ditches adequately drain the soil for cropping, but some areas require additional drainage. The native vegetation consisted of swamp grasses, sedges, and water-loving trees such as the swamp white oak, ash, and elm.

Profile in a cultivated area:

0 to 8 inches, very dark gray to black silty clay loam; high in organic matter; moderate medium granular structure; firm when moist; slightly acid to neutral.
8 to 18 inches, black to very dark brown silty clay loam; high in organic matter; moderate coarse granular to fine blocky structure; firm when moist; slightly acid to neutral.
18 to 28 inches, gray silty clay loam; faint yellowish-brown mottlings, especially in lower part; moderate coarse blocky structure; very firm when moist; neutral.
28 to 48 inches, mottled gray and yellowish-brown clay loam or silty clay loam; content of gravel variable and increases with depth; weak very coarse blocky structure; very firm when moist; neutral.
48 inches +, gray and pale-brown stratified gravel and sand; calcareous.

The total thickness of the upper two layers varies from about 16 to 24 inches. Those areas associated with Longlois soil usually have darker colored and thicker surface and subsurface layers than those associated with Fox and Ockley soils. The surface soil is a silt loam in some areas where material has washed onto this soil from the higher lying areas. The depth to calcareous gravel and sand ranges from 42 to about 65 inches, though the depth generally is less in those areas associated with Fox soils.

Use and management.—This soil is used and managed in about the same way as the associated Westland soils. Probably 80 percent or more of it is cultivated. The rotations commonly followed are (1) corn, soybeans, a small grain, and meadow, or (2) corn, a small grain, and meadow. Where a field is composed largely of this soil, corn likely will be grown 2 or more years in succession. Oats, wheat, and other small grains are not so well suited to this soil as to the better drained soils. Fall-seeded grains tend to winterkill, and they may lodge because the large supply of organic matter causes unbalanced fertility.

Meadow seedings, principally mixtures of red clover and timothy, are made with a small grain. Red clover and alfalfa can be grown successfully without liming, but they may be severely damaged by heaving and drowning out. Alfalfa normally is grown only on the adequately drained sites.

Wheat and corn usually receive a complete fertilizer. Potassium often is deficient in this soil because of poor drainage and the high organic-matter content. Efficient use of this soil requires adequate drainage, addition of fertilizer high in potassium, and use of a crop rotation having a high proportion of corn, or of corn and soybeans.

Brookston Series

Brookston silty clay loam, 0 to 3 percent slopes (Bc) (management subgroup 6A).—On the "black and clay" area of central Indiana, this is the principal dark-colored soil. It occurs in many lobed swales and depressions, where it is associated with the other members of the Russell catena and with members of the Miami catena. The soil was formed from medium-textured, limy glacial till of Wisconsin age.

Very poor drainage prevailed before settlement. Ponding was common, especially in the deeper swales. Although surface runoff and internal drainage are still very poor, most areas now are drained well enough by tile and open ditches to permit cropping. On the broad interstream divides where natural streams have not developed, the soil is intricately mixed with the light-colored Fincastle soil. The native vegetation was marshgrasses and water-tolerant trees, chiefly red maple, soft maple, elm, ash, and basswood.

Profile in cultivated areas:

0 to 8 inches, very dark brown to very dark grayish-brown silty clay loam; organic-matter content moderately high to high; weak medium granular structure; firm when moist, slightly plastic when wet, and slightly hard when dry; slightly acid to neutral.
8 to 14 inches, very dark brown silty clay loam; organic-matter content moderately high in upper part but decreases with depth; weak coarse granular or fine blocky structure; firm when moist, slightly plastic when wet, and hard when dry; slightly acid to neutral.
14 to 28 inches, mottled gray and yellowish-brown silty clay loam to light silty clay; moderate coarse blocky structure; very firm when moist, plastic when wet, and hard when dry; slightly acid to neutral.
28 to 58 inches, mottled gray and yellowish-brown clay loam to silty clay loam; moderate very coarse blocky structure; very firm when moist, plastic when wet, and hard when dry; content of sand and partially weathered rock fragments increases with depth; neutral.
58 inches +, mottled gray and yellowish-brown loam or light clay loam glacial till; calcareous.

The thickness of the first two layers ranges from about 8 to 16 inches. Where the Brookston soil grades to the Kokomo soil, the surface layer is darker colored, thicker, and higher in organic content than given above. Some of the small narrow areas in the shallower depressions have a silt loam surface texture, are lighter colored, and are somewhat more acid than normal. The depth to calcareous till varies from 38 to about 65 inches. The depth averages less in those areas associated with the Miami catena than in those associated with the Russell catena.

Use and management.—More than 95 percent of this soil is cultivated or in permanent bluegrass pasture. A grain-and-livestock system of farming is followed because this soil often occurs in small areas that are intricately mixed with light-colored soils.

The rotations in common use where this soil occurs with light-colored soils are (1) corn, oats or soybeans, wheat, and mixed hay or (2) corn, oats or wheat, and

[4] See section on soil survey methods and definitions for definition of the term "catena."

mixed hay. In fields where this Brookston soil occurs with Cope, Kokomo, or other dark-colored soils, it is managed like them, and corn is frequently grown 2 years in succession. A desirable 6-year rotation for this soil consists of corn, corn or soybeans, grain, meadow, corn, and grain with a sweetclover intercrop. This rotation provides a high proportion of corn, yet it maintains the structure, organic content, and fertility of the soil.

Corn usually follows hay in the crop rotation. It is either drilled or hill-dropped in the row and receives a complete commercial fertilizer at planting and a sidedressing of supplemental nitrogen. With good management and favorable weather, yields frequently exceed 100 bushels per acre, and a long-time average yield of 80 bushels may be obtained.

Soybeans, to which this soil is well adapted, are slightly more extensively grown than wheat. Although a few farmers continue to drill the beans solid, a more common practice is to drill them in rows in order to cultivate for weed control. They may be fertilized indirectly by doubling the application to the preceding corn crop or directly by drilling beside the row but not in contact with the seed. Since the soybean seedlings are sensitive to fertilizer, this crop generally is not fertilized.

Wheat is usually seeded after oats, soybeans, or a special crop such as tomatoes. In preparing land for seeding wheat, oats stubble is usually plowed, but land that has been used for soybeans or truck crops is disked. Yields are occasionally reduced by winterkilling and lodging of the grain. Wheat commonly receives a complete commercial fertilizer and supplemental nitrogen in the spring.

Oats is grown mainly as a feed crop. Yields vary according to weather, date of seeding, variety, and disease resistance. Early seeding is essential because the crop should mature before the dry period in midsummer. Yields have been materially increased by applying a complete fertilizer relatively high in nitrogen and by seeding the disease resistant, heavier yielding, stiff-strawed Clintland and Newton varieties.

Heavy applications of nitrogen may cause lodging of the grain on this soil. The light-colored associated soils are more responsive to fertilizer than this dark-colored soil.

Meadows are normally seeded with a mixture of grasses and legumes to insure a full stand. A legume sown alone makes an uneven stand because it partly winterkills where ponded water stands after rains. Satisfactory stands of alfalfa and clover can be obtained without the use of lime.

Sweet corn, tomatoes, and other special crops are well suited to this soil, but are grown mainly where a cannery is accessible. These crops usually are heavily fertilized; sweet corn yields 3½ to 5 tons per acre, and tomatoes 8 to 12 tons. Tomatoes yield more if they follow a legume meadow.

Carlisle Series

Carlisle muck (Ca) (management group 7).—Carlisle muck has formed from decomposing grass, sedge, and woody peat in former ponds and permanent marshes. It is associated with soils of the uplands, terraces, and bottoms and occurs where permanent saturation favors growth of plants and retards their decay.

This soil occurs mainly in kettle holes on the upland, in former glacial drainageways, and in the lowest places in stream bottoms. Drainage, principally by open ditches, makes most areas tillable. Drainage is often difficult and sometimes impractical because outlets are hard to find. The native vegetation originally was sedges, grasses, marsh grasses, and reeds, but elm, ash, soft maple, aspen, and willow have invaded.

Profile in cultivated areas:

0 to 8 inches, black muck; well decomposed and contains numerous woody fragments; strong fine granular structure; very friable when moist and hard when dry; medium to slightly acid.

8 to 20 inches, black muck; well decomposed and contains numerous partly decomposed woody fragments mixed with organic material from reeds and sedges; medium coarse granular structure; slightly compact in lower part; medium to slightly acid.

20 to 42 inches +, dark-brown mucky and peaty material that grades to brownish-yellow peat with depth; upper part more thoroughly decomposed than lower; contains distinguishable roots, twigs, and some wood.

The soil varies chiefly in depth, degree of decay, and acidity. Approximately 20 acres of Wallkill silt loam, a soil not mapped separately in this county, were included with this soil. This Wallkill soil consists of 10 to 40 inches of grayish-brown colluvial wash, largely silty material, over the muck.

Use and management.—Although this soil is used mainly for corn and permanent pasture, it is well suited to special crops. Corn is grown almost continuously on some areas. Principal limitations on yields are the short growing season, frost damage, improper and inadequate fertilization, and inadequate drainage. Areas inadequately drained for crops are used mainly for permanent bluegrass pasture. Such pastures produce abundantly through the growing season if weeds are controlled. Small grains are not well suited to this soil because its large supplies of nitrogen tend to produce excess straw and cause lodging of the crop. To balance this high nitrogen supply, adequate amounts of potassium, particularly, and phosphorus must be applied.

Potatoes, sweet corn, mint, onions, carrots, celery, and other special crops are well adapted but seldom grown, probably because the soil covers such a small area. High yields of potatoes can be obtained if the crop is adequately fertilized.

Controlled drainage, whereby the water table can be raised or lowered, may increase the suitability of some areas for special crops of high acre value. This reduces soil shrinkage and increases the efficiency of tile drainage systems.

Cope Series

The Cope soils, locally known as gray loams, are similar to the Brookston soil, but they are lighter colored and have less organic matter in the surface

soil. Although naturally poorly to very poorly drained, they occupy shallower upland depressions where ponding is less pronounced than in areas occupied by Brookston soil. Most areas are now well enough drained for cropping.

The Cope soils are members of the catena that includes the very poorly drained Brookston and Kokomo soils of the successively deeper depressions; the imperfectly drained, light-colored Fincastle soil of the slightly higher flats; and the well-drained Russell soils of the sloping areas. The parent material consists of a highly calcareous loam glacial till of Wisconsin age. The natural vegetation developed was marsh grasses, sedges, and red maple, soft maple, ash, elm, beech, and other water-tolerant trees.

Cope silt loam, 0 to 3 percent slopes (Cb) (management subgroup 6A).—This soil occurs on broad shallow flats and in many lobed depressions. It is intricately mixed with light-colored Fincastle silt loam throughout the upland area. It normally occurs on the broad interstream divides where there has been little stream development. Where local streams are cutting into the plains, it may occupy narrow depressions at the heads of streams.

Representative profile for cultivated areas:

0 to 8 inches, dark-gray to very dark gray silt loam; organic-matter content is medium; moderate medium granular structure; slightly hard when dry; slightly to medium acid.
8 to 14 inches, grayish-brown silt loam to light silty clay loam; medium to low organic-matter content; moderate coarse granular structure; firm when moist; slightly to medium acid.
14 to 48 inches, mottled gray, yellow, and brown silty clay loam to clay loam; moderate coarse blocky structure; firm when moist and plastic when wet; slightly to medium acid in upper part, and gradual change to neutral in the lower part.
48 inches +, mottled gray and yellowish-brown loam glacial till; calcareous.

The dark-colored surface layer varies from 7 to about 12 inches in thickness. In many places the soil includes small areas of Brookston soil. The subsoil is light silty clay loam in some areas. The depth to calcareous till ranges from 38 to about 60 inches.

Use and management.—Probably 95 percent of this soil is cultivated. A grain-and-livestock system is followed. The farmers keep some dairy cows and raise beef cattle, hogs, and some sheep. Because of the need for roughage and the intricate mixture of this soil with the light-colored Fincastle soil, farmers commonly use a 3-year rotation of corn, wheat, and meadow, or a 4-year rotation of corn, soybeans or oats, wheat, and meadow. Where this soil is in fields occupied dominantly by Brookston, Kokomo, or other dark-colored soils, corn is frequently grown 2 years or more in succession.

Corn usually follows hay in the rotation. It is normally drilled in the row, but it may be hill-dropped. Generally corn receives a complete commercial fertilizer.

Soybeans are well suited to this soil and are about as extensively grown as wheat. They are grown almost entirely for grain. A few farmers continue to drill the beans solid, but most of them drill in rows spaced 2 feet or more apart so they can control weeds by cultivating. The beans may be fertilized by making a heavy application to the preceding crop or by drilling fertilizer beside the row. The seedlings are injured if fertilizer is placed in contact with the seed.

Wheat is normally grown in the crop rotation following oats, soybeans, or special crops such as tomatoes. Occasionally it is seeded in standing corn. The oats stubble is plowed before the wheat is seeded and the fields used for truck crops are disked. Winterkilling and lodging occasionally reduce yields. Wheat ordinarily receives an application of complete commercial fertilizer.

Oats are grown mainly as a feed crop. Yields vary widely because of weather, date of seeding, variety, and disease resistance. The crop must be seeded early so that it will mature before the hot, dry period in midsummer. Newton, Clintland, and Bentland are popular varieties. They are disease resistant, stiffer strawed, and produce higher yields, especially if they receive a complete fertilizer high in nitrogen. This light-colored soil responds to heavy fertilization better than the very dark colored soils with which it is associated.

Excellent stands of alfalfa and clover are grown without the use of lime, but frequently there is some damage from winterkilling. To insure a full stand, meadows are usually seeded with a mixture of grass and legumes. Alfalfa may be used as part of the meadow mixture, but it is seeded alone only where the soil is adequately drained and the stand is to be left 2 years or more.

Cope silty clay loam, 0 to 3 percent slopes (Cc) (management subgroup 6A).—This soil occurs in shallow depressions on the upland divides. Except for having a surface layer that contains more clay, it is similar to Cope silt loam, 0 to 3 percent slopes. The clay makes the surface soil sticky and plastic when wet. If tilled when wet, hard clods form that are difficult to break. When the soil dries out, wide, deep cracks develop.

Use and management.—The crops grown, management needed, and yields obtained are similar to those on Cope silt loam, 0 to 3 percent slopes. This silty clay loam, however, is somewhat better for corn and produces slightly higher average yields. Since this soil occurs in broader and somewhat deeper swales, wheat, clover, and alfalfa may be more damaged by heaving and winterkilling than on Cope silt loam, 0 to 3 percent slopes.

Crosby Series

Crosby silt loam, 0 to 3 percent slopes (Cd) (management group 5).—This imperfectly drained, light-colored soil has developed from unsorted silt, clay, sand, and glacial rock fragments that have been leached of carbonate of lime to depths of from 24 to 42 inches. It is on the "black and clay lands," that is, where Brookston and Crosby soils occur together. This light-colored Crosby soil is on the high areas, and the darker Brookston on the low. Usually the difference in elevation is less than 2 feet, so the soils are more easily distinguished by differences in color. The

native vegetation on this soil consisted chiefly of sugar maple and beech, mixed with elm, ash, gum, and white oak.

Profile in cultivated areas:

0 to 7 inches, grayish-brown silt loam; weak medium granular structure; friable when moist; low organic-matter content; medium acid; in undisturbed wooded areas the top 2 to 3 inches is very dark grayish brown and relatively high in organic matter.
7 to 10 inches, grayish-brown silt loam; weak thin platy structure; friable when moist; medium acid.
10 to 17 inches, mottled gray and yellowish-brown clay loam to silty clay loam; moderate fine subangular blocky structure; firm when moist; medium to strongly acid.
17 to 30 inches, mottled gray and yellowish-brown clay loam to silty clay loam; moderate coarse subangular blocky structure; firm to very firm when moist and hard when dry; medium acid.
30 to 34 inches, dark-brown to brown, mottled with gray and yellowish-brown, heavy clay loam to clay loam; moderate very coarse subangular blocky structure; very firm when moist and plastic when wet; slightly acid to neutral.
34 inches +, mottled gray and yellowish-brown loam to light clay loam glacial till; weak very coarse blocky to weak very coarse platy structure; firm; calcareous.

Depth to mottling varies from 6 to about 16 inches. Where this soil grades to the Brookston and Cope soils, its surface soil is usually somewhat darker in color and occasionally heavier in texture than that given above. The depth to calcareous till generally ranges from 24 to 42 inches.

The small areas of this soil that occur east of Camden in association with the Fincastle group of soils frequently have smooth, relatively grit-free surface soil of variable depth, a moderately heavy subsoil, and friable gritty material above the calcareous till. Here the depth to calcareous till varies from 36 to 60 inches or more. Along the northern border of the county, a few areas of small total acreage have been included that have a considerable amount of fine sand in the surface layer and throughout the soil. A few acres that have slopes of about 4 percent are included. Some of these areas have lost some of the surface soil through erosion.

Use and management.—Practically all of this soil is cultivated or in bluegrass pasture. Less than 10 percent remains in forest. A grain-and-livestock system of farming is followed. Corn, soybeans, wheat, and meadow—the principal crops—are usually grown in a 4-year rotation. A 3-year rotation of corn, wheat, and red clover or mixed hay, once popular when wheat was seeded in the standing corn, is still followed to some extent.

About 25 percent of this soil is used for corn. Because the soil has a relatively low organic-matter content, crop residues and all available manure are turned under to improve the tilth and productivity. Maximum yields frequently are not attained on Crosby and similar soils because of limited supplies of potassium and nitrogen. Improved hybrid varieties are generally used. Many farmers apply a complete commercial fertilizer.

Like corn, soybeans grown for grain are fertilized. Wheat normally receives a complete fertilizer at planting, and yields can be further increased by adding soluble nitrogen in spring. Oats are profitably grown by following such practices as early seeding, use of disease-resistant high-yielding varieties such as Clintland and Bentland, and the application of a complete fertilizer.

Legume-grass meadows are normally seeded in a nurse crop of wheat or oats. The grass is seeded in the fall and the clover early in spring. Seeding the clover in spring reduces losses caused by drought and winterkilling. Red clover makes a better stand on this soil than on Fincastle silt loam, 0 to 3 percent slopes, because this soil is less acid. Alfalfa can be grown successfully if this soil is adequately drained and limed. Good alfalfa yields require application of a fertilizer high in potassium, for example, 0-10-20.

Edwards Series

Edwards muck (Ea) (management group 7).—This soil occupies a small acreage and is associated with Carlisle muck. It is similar to Carlisle muck in color, degree of decomposition, and kind of plant cover under which it formed. It differs in having a substratum of light-gray, soft, silty marl at depths averaging about 18 inches and ranging from 12 to 42 inches. The marl contains shells in many places and varies greatly in lime content and value. It is widely used as a source of agricultural lime.

Although the soil ranges from alkaline to medium acid, it is only slightly acid in most places. Areas that are neutral to alkaline may be unsatisfactory for potatoes, because of potato scab. Where the marl is mixed with the surface soil, potassium deficiency may be more serious than for Carlisle muck. Except for potatoes, the soil is suitable for about the same crops as the other mucks.

Eel Series

The Eel series consists of moderately well drained soils occurring in small stream valleys and in shallow swales and old meander channels of the larger streams. They are associated with the well-drained Genesee and Ross soils. Their parent material is neutral to calcareous stream sediments washed from the timbered Wisconsin drift region. Originally the soils were covered with a dense forest consisting chiefly of beech, sycamore, soft maple, ash, and elm. Much of the timber has been cut, and the soils are now used for crops and permanent pasture.

Eel silty clay loam, 0 to 3 percent slopes (Ed) (management subgroup 8B).—This soil occurs in swales and old stream channels on the wider bottoms of the rivers. It lies 1 to 3 feet lower than the adjacent Genesee soils, so it is flooded more frequently and for longer periods.

Profile in a cultivated area:

0 to 8 inches, grayish-brown silty clay loam; moderate medium granular structure; slightly firm; neutral.
8 to 20 inches, grayish-brown to pale-brown silty clay loam; may contain thin lenses or layers of silt and sand; weak coarse granular structure; firm; neutral to mildly alkaline.
20 to 40 inches +, mottled gray and yellowish-brown silty clay loam; contains lenses and layers of silt and sand; firm; neutral to calcareous.

Included with this soil are a few more poorly drained areas in the deeper depressions of old channels. These have a light brownish-gray surface soil, 8 to 12 inches deep, that is underlain by subsoil of mottled gray and yellowish-brown compact silty clay loam. Moisture movement in these areas is appreciably slower.

Use and management.—Because it is wetter and more frequently flooded, this soil is less intensively used than the associated Genesee soils. Probably 33 percent of it is wooded or in woodland pasture, and about 12 percent is used as permanent pasture. It needs protection from erosion and structures to prevent changes in the stream course. Tillage is usually delayed, and early plantings of corn are often drowned out. Consequently, replanting to corn or soybeans may be necessary. Although it is as fertile as the associated Genesee soils, the soil is colder and wetter, and yields are therefore lower. Small grains, particularly wheat, are seldom grown, because they are so frequently damaged or destroyed by overflow.

Eel silt loam, 0 to 3 percent slopes (Ec) (management subgroup 8B).—This is the dominant soil in the small stream bottoms in the timbered Wisconsin drift region. The Genesee are the principal associated soils. They occur principally on the slightly higher natural levee positions. This soil is in the low back bottoms, bordering the terraces and upland areas.

The surface soil, to a depth of 6 to 8 inches, is a grayish-brown friable silt loam that contains variable amounts of gritty or sandy material. The subsurface layer is brown or yellowish brown. At depths of 15 to 30 inches, this layer grades to mottled gray and yellowish-brown silt loam. The sand often occurs in thin layers and is mixed with twigs, leaves, and other debris deposited during overflows. Water moves freely through the soil, so it can be drained readily if suitable outlets are available.

Included with this soil are a few areas in lower depressions. These have poor natural drainage, are grayer on the surface, and have a more highly mottled subsoil.

Use and management.—Because this soil occupies narrow irregular shaped bottoms, about 66 percent is wooded or in permanent pasture. Corn is the principal crop. Small grains, however, are grown more often on this soil than on Eel silty clay loam, 0 to 3 percent slopes. The soil permits rotations consisting of corn, a small grain, and meadow because it is less susceptible to overflow than the Eel silty clay loam. Corn and soybeans yield about the same as on the silty clay loam, but wheat yields slightly more.

Eel loam, 0 to 3 percent slopes (Eb) (management subgroup 8B).—This soil occurs on bottoms along the larger rivers and the small tributary creeks. The 6- to 8-inch surface soil is a grayish-brown loam that has a relatively high organic-matter content. The amount of organic matter decreases with depth. The subsoil is brown or grayish-brown silt loam. Below depths of 15 to 30 inches, the subsoil is mottled gray and yellowish-brown loam that contains varying amounts of sand and occasionally some fine gravel. The entire profile is neutral to calcareous.

Use and management.—About 25 percent of this soil is timbered, and nearly 40 percent is used for pasture. Many of the areas along streams may be flooded during heavy rains. The woodland cover is therefore necessary to restrict flood damage and changes in the stream course. For the areas cropped, yields similar to those on Eel silt loam, 0 to 3 percent slopes, are obtained.

Included with this soil are a few areas that have a relatively loose fine sandy loam surface soil and somewhat lower fertility.

Farmington Series

Farmington silt loam, 0 to 4 percent slopes (Fa) (management subgroup 1E).—This soil is on rock terraces in the Wabash River valley. It is a very shallow, well-drained, neutral, moderately dark colored soil, formed largely from glacial drift. The drift contains much limestone residuum. The soil is nearly level; the slope to the adjoining bottom rarely exceeds 5 percent and is normally 4 percent or less. Surface drainage ranges from slow to medium. Internal drainage is adequate because the water seeps away through cracks in the limestone.

This soil is associated with the Milton and Fox soils, which contain more glacial drift. It was originally covered with a mixed stand of hardwood timber, but most of it has been cleared and is now used largely for permanent pasture.

Profile description:

0 to 8 inches, dark grayish-brown silt loam; moderate fine granular structure; friable; neutral to mildly alkaline.
8 to 16 inches, dark-brown silt loam to light silty clay loam; moderate fine subangular blocky structure; firm; contains some glacial pebbles and rocks; lower 2 or 3 inches is smooth heavy silty clay loam, which probably was derived from limestone material; neutral to alkaline.
16 inches +, limestone bedrock.

The depth to bedrock varies from 6 to about 24 inches within short horizontal distances.

Use and management.—Most of this soil has been cleared of timber. It was probably cropped in the past, but it is now used mainly for permanent pasture. Most of the common crops are grown. The soil is best for permanent pasture, legume-grass meadow, and drought-resistant crops such as alfalfa, wheat, and soybeans. Corn and oats can be grown only if rainfall is evenly distributed throughout the growing season.

Although the soil is inherently very fertile, it is so shallow and holds so little moisture that crops cannot stand much dry weather. Also, in the very shallow areas, stones may interfere with tillage.

If the soil is cropped, these rotations are suitable: A 4-year rotation consisting of corn, a small grain, and meadow for 2 years; or a 6-year rotation made up of corn, soybeans, wheat, and alfalfa-bromegrass for 3 years. All available crop residues should be returned to build up the moisture-holding capacity of the soil.

Fincastle Series

Fincastle silt loam, 0 to 3 percent slopes (Fb) (management group 5).—This light-colored imperfectly

drained soil occupies the broad gently undulating upland divides. It is a member of the catena that also includes the well-drained Russell soils and the very poorly drained Cope, Brookston, and Kokomo soils. It has developed chiefly on loess, 18 to 36 inches thick, over material weathered from loam till. Calcareous till occurs at depths of 42 to 60 inches or more.

In drainage and color this soil is similar to Crosby soils, but it differs in having smooth silty surface soil and upper subsoil that are relatively free of grit and pebbles and are stronger in acidity. Its depth to calcareous till also is greater.

Fincastle soil lies in level to gently undulating areas below the knolls of Russell soils and above the dark-colored Cope and Brookston soils of the shallow depressions. Slopes are dominantly less than 1 percent, and the relief to the lower lying Cope or Brookston soils rarely exceeds 1 to 2 feet. Internal and surface drainage are slow, so it is necessary to drain the soil, usually with tile, if it is to be managed efficiently and yields are to be improved. Most of it has been partly drained by laying tile through the adjacent dark-colored soils of the swales and depressions, but some of the larger areas need additional drainage. The native cover was beech, sugar maple, elm, sweetgum, sourgum, and black oak.

Profile in cultivated areas:

0 to 7 inches, grayish-brown smooth silt loam; weak medium granular structure, friable when moist and soft when dry; organic content is low; medium to slightly acid..

7 to 11 inches, grayish-brown smooth silt loam; weak platy or weak coarse granular structure; strongly acid.

11 to 18 inches, mottled gray and yellowish-brown light silty clay loam; moderate fine subangular blocky structure; slightly firm when moist; strongly acid.

18 to 30 inches, mottled gray and yellowish-brown silty clay loam; moderate medium to coarse subangular blocky structure; firm when moist, hard when dry, and plastic when wet; contains some sand and small rock fragments in lower part; strongly acid.

30 to 55 inches, mottled gray and yellowish-brown clay loam; moderate coarse to very coarse subangular blocky structure; very firm when moist and hard when dry; strongly acid in upper part, grading to slightly acid in lower part; lower 2 to 4 inches is darker colored than material above.

55 inches +, yellowish-brown, mottled with gray, loam glacial till; compact in place; calcareous.

Where this soil grades to the Cope or Brookston soils its surface layer is somewhat darker and less acid than normal. Depths to mottling range from 7 to about 17 inches. The depth to calcareous till ranges from 42 to 60 inches or more.

Included with this soil are small level areas on broad divides that have gray surface soil and compact impervious subsoil. In places the smooth, grit-free soil may extend to depths of 3 feet or more. Elsewhere the soil resembles Crosby soil in that it has a gritty surface soil and variable amounts of sand and gritty material from the surface downward.

Use and management.—About 95 percent of this soil is cropped or used for pasture. A grain-and-livestock system of farming is practiced. The crop rotations most commonly followed are (1) corn, soybeans, wheat, and hay; or (2) corn, oats or wheat, and hay. Most crops, except soybeans and wheat, are fed to livestock on the farm.

Corn usually follows hay in the rotation. Occasionally, it is grown 2 years in succession, especially where this soil is mixed with a large proportion of dark-colored Cope and Brookston soils. Management that gets the best yields includes the use of legumes, liberal application of fertilizer, and return of manure and crop residues to the land. The grain-livestock system gives the best opportunity for adding organic matter and increasing corn yields, especially if manure from some feed not grown on the farm is spread on the fields.

Soybeans usually are grown following corn. To get quality beans, it is necessary to control weeds. Most of the farmers therefore have changed from solid seeding to drilling in rows 2 feet or more apart. Soybeans generally are not fertilzed, because the seedlings are easily injured by fertilizer. Nevertheless, up to 150 pounds per acre of fertilizer can be applied in the row with a divided fertilizer attachment, or a heavy application may be plowed down in preparing the land for the preceding corn crop.

Oats are grown mainly for livestock feed. Yields vary widely. New disease-resistant varieties, such as the Newton, Clintland, or Bentland, are rapidly replacing all others. Oats normally are seeded early in spring to avoid the hot, dry weather common in the latter part of June. They respond well to a complete commercial fertilizer that contains a liberal amount of nitrogen.

Wheat ordinarily follows oats or soybeans but is sometimes seeded in standing corn or in the stubble immediately after the corn is harvested. A topdressing of 2 tons of manure applied early in winter greatly reduces winterkilling, which occasionally is serious on this soil. The application of a complete fertilizer at planting time and topdressing with nitrogen in spring are suggested.

Meadow seedings are made in nurse crops of wheat or oats. A legume-grass mixture is used to insure a full stand. In meadows planned to last 1 year, red clover, alsike clover, and timothy are usually seeded. If the meadow is to stand 2 years or more, alfalfa and timothy or bromegrass are frequently used. Drought is the principal hazard to red clover seeded alone. Sweetclover, another deep-rooted legume, is sometimes seeded in wheat to improve internal drainage and to increase the supply of nitrogen and organic matter.

Fox Series

The Fox soils occur on low terraces bordering the bottom lands, on higher terraces or former outwash plains, on terrace escarpments, and on kames and moraines of the uplands. They have developed on silty and loamy deposits of outwash, 24 to 42 inches thick, that overlies loose, stratified, calcareous gravel and sand. Fox and Nineveh are the well drained to excessively drained soils of the catena that includes the imperfectly drained Homer soil. The Fox soils were developed under a mixed forest cover of black and red oak, sugar maple, walnut, hackberry, and ash.

Fox loam, 0 to 3 percent slopes (Ff) (management subgroup 2A).—This soil occurs on terraces and benches in the river and stream valleys.

Profile in cultivated areas:

0 to 8 inches, brown to grayish-brown loam; weak medium granular structure; friable when moist and soft when dry; low in organic matter (in undisturbed wooded areas the surface 2 to 3 inches is very dark grayish brown and is relatively high in organic matter); medium to slightly acid.
8 to 12 inches, yellowish-brown to brown loam; moderate fine subangular blocky to weak coarse platy structure; friable when moist; medium acid.
12 to 18 inches, dark yellowish-brown to dark-brown light clay loam; moderate fine subangular blocky structure; slightly firm when moist and hard when dry; contains variable but usually small amounts of gravel; medium acid.
18 to 36 inches, brown to reddish-brown clay loam to gravelly clay loam; moderate coarse to very coarse subangular blocky structure; firm to very firm when moist and hard when dry; medium acid.
36 to 40 inches, dark-brown to very dark brown gravelly or sandy clay loam; weak very coarse blocky structure; very firm when moist, plastic when wet, and hard when dry; neutral; tongues of this layer extend into underlying material.
40 inches +, pale-brown or light brownish-gray loose stratified gravel and sand; calcareous.

The proportion of gravel in the soil and parent material is quite variable. Occasionally coarse gravel is present in considerable amounts on or near the surface. At the point of contact with the limy gravel, the dark-brown layer varies greatly in color, and thickness. The depth to loose gravel and sand ranges from 24 to about 42 inches.

Use and management.—More than 90 percent of this land has been cleared and is now used for crops and pasture. A grain-and-livestock system of farming is usually followed. The principal crop rotation consists of corn, soybeans, wheat, and mixed meadow. Because of the low moisture supply, the soil is not well suited to oats, and corn yields vary with weather conditions. Careful management of this soil requires the growth and turning under of cover crops and green-manure crops to increase the organic-matter supply and the moisture-holding capacity. Growing of hay and pasture crops is desirable, especially deep-rooted legumes such as alfalfa and sweetclover.

Red clover, seeded alone or in mixture with timothy and alsike clover, is not well suited to this soil because it is frequently damaged by drought. The meadows are commonly thin and unproductive. Alfalfa, seeded alone or in mixture with bromegrass and Ladino clover, is better suited because of its drought resistance and high productivity. Sweetclover is sometimes used as a cover crop to provide pasture and green manure. As a winter cover crop, it is sown in corn at the last cultivation. For pasture and green manure, it is sown in a small grain in the spring. Liming is necessary for successful growth of all legumes, and particularly for sweetclover.

Kentucky bluegrass furnishes excellent pasture but has a long dormant period during July and August. The more progressive stockmen therefore use rotation meadows seeded principally in alfalfa-grass mixtures, or they provide supplementary pastures of sudangrass.

Fox loam, 3 to 8 percent slopes (Fp) (management subgroup 2B).—This soil occurs on short slopes around drainageways and as long narrow strips above terrace breaks or escarpments. It differs from Fox loam, 0 to 3 percent slopes, in having slightly greater runoff. Therefore, it is susceptible to erosion if cultivated improperly. Most areas of this soil are long and narrow and can be tilled across the slope. A few areas bordering depressions and kettle holes have irregular slopes that make contour tillage impractical.

Use and management.—This soil is not cultivated so intensely as Fox loam, 0 to 3 percent slopes. Approximately one-third of it is in forest or permanent pasture. Farmers grow less corn and soybeans on this soil than in Fox loam, 0 to 3 percent slopes, and more meadow crops, particularly alfalfa. This soil is well suited to alfalfa. Under present use and management little erosion has occurred.

Fox loam, 3 to 8 percent slopes, eroded (Fg) (management subgroup 2C).—Under intensive cultivation, this soil is susceptible to erosion. It occurs mainly around drainageways. About one-third of it has been moderately to severly eroded. The surface soil is grayish-brown loam to yellowish-brown heavy loam. Where erosion has been severe, the original surface soil is thin, and in some places the subsoil is exposed. Such areas have more clayey surface layers, are not so easily worked, have slower moisture intake, and have a lower moisture-holding capacity. Much of the nitrogen, organic matter, and phosphorus have been lost.

Use and management.—This soil is used as intensively as the phase occurring on 0 to 3 percent slopes. Since the areas occupied by this soil are small, little attention has been given to controlling erosion. Consequently, yields of all crops have been greatly reduced. The soil responds well to the management practices suggested for the Fox loam, 3 to 8 percent slopes, but greater attention must be paid to organic-matter content, moisture-supplying capacity, and fertilization, particularly with phosphorus.

Fox loam, 8 to 12 percent slopes (Fh) (management subgroup 2D).—This soil occurs as long narrow strips around heads of drainageways, above the breaks of terraces, and on the escarpments of both the low and high terraces. It is extensively developed on the escarpments of higher terraces, where it is associated with Ockley soils. Where this soil is associated with the Ockley soils it has more silty surface layers, more clayey, moisture-retentive subsoils, and somewhat greater depth to gravel than it does on lower terrace positions.

Use and management.—Under cultivation this soil is susceptible to severe erosion, but its use for permanent pasture and timber has protected it. If contour tillage is practiced and a high proportion of small grains and hay crops is grown in the rotation, erosion can be controlled and crop yields maintained. Since tillage implements can be operated across the short slopes of this soil, its use is largely determined by use of the associated soils. A rotation consisting of corn, wheat, and mixed alfalfa-bromegrass meadow for 2 or 3 years is suggested.

Fox loam, 8 to 12 percent slopes, eroded (Fk) (management subgroup 2D).—This soil occurs in numerous

small areas on the breaks of terraces, but chiefly on the longer slopes of the higher terraces where it is associated with Ockley soils. It is similar to Fox loam, 0 to 3 percent slopes, except for its greater relief and thinner surface soil. The present surface soil is yellowish-brown to brown heavy loam to clay loam.

Use and management.—Most of this soil has been cleared and is now used for permanent pasture or crops. It is cropped as intensively as Fox loam, 3 to 8 percent slopes, usually because it occurs as small areas in fields with that soil. However, losses of soil, organic matter, fertility, and capacity to hold moisture make this soil less productive.

Erosion can be controlled and fertility built up by tilling along the contour, terracing, and stripcropping, and by following a crop rotation consisting of corn, wheat, and a mixture of alfalfa and bromegrass for 2 or 3 years. Without conservation practices, corn should not be grown. Where fields contain only small areas of this soil, they can be cropped safely without conservation practices by omitting corn and retaining meadow another year.

Fox loam and clay loam, 8 to 12 percent slopes, severely eroded (Fc) (management subgroup 2E).—This soil occurs principally on the breaks of the higher terraces and is associated with Ockley soils. Small steeper areas are included. The soil differs from Fox loam, 0 to 3 percent slopes, principally in relief, loss of nearly all its surface soil, and its shallow depth to gravel and sand. The plow soil usually is a clay loam formed through mixing of the subsoil with the surface soil. In some locations all of the subsoil has been removed and loose gravel and sand are exposed.

Use and management.—This soil was cultivated until erosion and declining crop yields caused farmers to allow much of it to lie idle or return to permanent pasture. It is best suited to meadow, permanent pasture, or forest. Areas that are not so severely eroded can be used if a suitable 4-year crop rotation, such as wheat, followed by alfalfa-bromegrass meadow for 3 years is used, and contour tillage is practiced.

Fox loam, 12 to 25 percent slopes (Fl) (management subgroup 2E).—This soil occurs on the breaks of higher terraces. Both surface soil and subsoil contain more gravel than Fox loam, 0 to 3 percent slopes, and depth to gravel and sand is less. Where this soil is associated with Ockley soils, it is generally deeper and more retentive of moisture. Where the slopes are steeper, it grades to Rodman gravelly loam, 25 to 60 percent slopes.

Use and management.—This soil is best suited to permanent pasture and forest, but about one-third of it is in crops. Small areas of this soil are often cultivated where they occur in fields with Ockley and other Fox soils. In these areas crop yields are low and risk of erosion is serious.

Fox loam, 12 to 25 percent slopes, eroded (Fm) (management subgroup 2E).—This phase is similar to Fox loam, 12 to 25 percent slopes, in character and position, but much surface soil has been lost through erosion. The present surface layer is a brown heavy loam to yellowish-brown clay loam or gravelly clay loam. Because of susceptibility to erosion and low productivity, this soil is best suited to permanent pasture and forest.

Use and management.—Although much of this phase is now used for permanent pasture, erosion started by intensive cultivation in the past is still active in those pastures where the plant cover is so thin it does not provide enough protection from rainfall. Yields are now low on areas cropped, and they become lower as erosion continues to remove surface soil. Thin stands of pasture grass should be renovated by applying lime and phosphorus and then seeding with drought-resistant legumes, such as alfalfa, Ladino clover, and birdsfoot trefoil.

Fox loam and clay loam, 12 to 25 percent slopes, severely eroded (Fd) (management subgroup 2E).—This soil occurs on the steeper breaks of terrace escarpments. The surface soil is yellowish-brown or dark yellowish-brown clay loam to gravelly clay loam, with small areas of heavy silt loam. The depth to loose gravel and sand averages considerably less than in Fox loam, 0 to 3 percent slopes. The areas of this soil are small and unproductive, but they are farmed along with less sloping and more productive soils. Crop yields are usually too low to justify tillage. Nevertheless, some of the more gently sloping areas might be used effectively for longtime meadows. The slightly gullied and more severely eroded areas are more suitable for permanent pasture and forest.

Fox loam, 3 to 8 percent slopes, eroded kame phase (Ba) (management subgroup 2C).—This soil occurs on knolls and ridges on the till plain, usually at levels above the till plain. It is associated chiefly with Miami soils. The slopes vary in shape, degree, and length within short distances. In profile characteristics this soil is similar to Fox loam, 0 to 3 percent slopes. It differs in configuration of slope, in greater variability in depth to gravel and sand, in inclusion of small areas of Miami soils in some areas, and in having lost a considerable part of the surface soil through erosion.

The present surface soil, or plow soil, ranges from brown heavy loam to yellowish-brown clay loam. Included with this soil are a few areas of Russell soils that have silt loam surface soils and silty clay loam upper subsoils.

Fox loam, 8 to 25 percent slopes, eroded kame phase (Bb) (management subgroup 2D).—This soil occupies the steep parts of the knolls and ridges in the upland; it is associated with the other kame phase of Fox loam and with Miami soils. The shape, degree of slope, and length of slope vary greatly.

The present surface soil varies from grayish-brown loam to yellowish-brown gravelly clay loam; texture depends upon the amount of former surface soil removed. Depth to loose gravel and sand is generally less than 30 inches. Included with this soil are small areas having numerous gullies and some small areas having slopes greater than 25 percent.

Use and management.—Most of this soil has been cleared and cultivated; however, less than half of it is now cropped. Corn, wheat, and mixed hay are the principal crops. The low moisture supply and susceptibility to erosion make wheat and alfalfa the best

crops for this soil. The moisture-holding capacity is too low for growing oats, and row crops do not provide enough protection from erosion.

Fox fine sandy loam, 0 to 3 percent slopes (Fe) (management group 3).—This soil occurs principally in the valley along the Tippecanoe River, where it is associated with the Fox loam soils and with Oaktown loamy fine sand. Where this soil borders the Oaktown, it is somewhat undulating because winds have shifted the sandy surface layer. Slight surface runoff may occur during heavy rains, but rain usually is absorbed as fast as it falls. Internal drainage is rapid, and the moisture-holding capacity is low. During periods of low rainfall, crops frequently are damaged.

The surface soil to a depth of 12 inches is a light-brown to grayish-brown fine sandy loam, relatively low in organic matter. This is underlain by dark-brown to dark yellowish-brown sandy clay loam. Below a depth of about 18 inches is dark-brown gravelly clay loam to gravelly and sandy clay loam. This layer is underlain at depths of about 30 to 44 inches by loose stratified calcareous gravel and sand.

Use and management.—Most of this light sandy soil (fig. 11) is cleared, but only about half of it is cropped. It is used for about the same crops as the heavier Fox soils, but yields are lower because of the limited supply of moisture. Heavy applications of fertilizer are not advisable because plants grow too rapidly early in the season; consequently, during the dry season there is not enough moisture to mature the grain. Soybeans, wheat, rye, and alfalfa are the crops best suited. Oats and clover are often severely damaged by drought. Alfalfa, seeded alone or in mixture with bromegrass and Ladino clover, provides the most satisfactory and productive hay or rotation pasture.

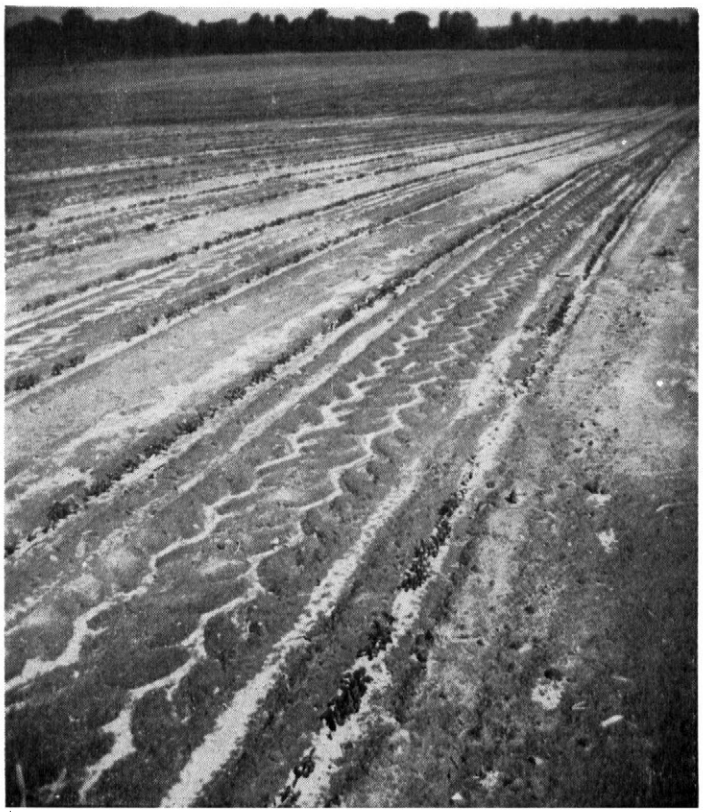


Figure 11.—View of Fox fine sandy loam showing rows of emerging soybeans and light-colored coarser grains of sand exposed by beating rains.

The soil is moderately well suited to Kentucky bluegrass, but permanent pastures are frequently thin, weedy, and relatively low in carrying capacity. Renovation to increase the carrying capacity requires the addition of lime and fertilizer and the introduction of a drought-resistant legume, such as alfalfa, birdsfoot trefoil, or Ladino clover. A suggested crop rotation consists of corn, wheat, and alfalfa-bromegrass for 2 or 3 years.

Fox silt loam, 0 to 3 percent slopes (Fn) (management subgroup 2A).—This soil occurs on nearly level to slightly undulating terraces that usually lie less than 10 feet higher than the flood plain. Surface runoff is slight, but internal drainage is moderately rapid, even in the shallow depressional areas.

Profile characteristics are similar to those of Fox loam, 0 to 3 percent slopes, except for a silt loam surface soil, a silty clay loam upper subsoil, and a slightly greater average depth to calcareous gravel and sand.

Use and management.—Most of this soil has been brought under cultivation. Its use and management are similar to those on the Fox loams. Since its moisture-holding capacity is better than on the Fox loam soils, corn is more extensively grown and clover fails less often. Consequently, a crop rotation of corn, soybeans, wheat, and hay can be more consistently followed.

Mixed meadow seedings are usually made. The seeding mixture normally consists of red clover, alsike clover, and timothy, and it frequently includes some alfalfa. Although clover is better on this soil than on the Fox loams, some of it dies out because of drought. For this reason, seeding of red clover alone is not advisable. Alfalfa, seeded alone or in mixture with bromegrass or timothy and Ladino clover, is better suited than red clover and more productive of both hay and pasture. Sufficient lime must be applied if alfalfa is to be grown successfully.

Fox silt loam, 3 to 8 percent slopes (Fo) (management subgroup 2B).—In all characteristics except slope this soil is similar to Fox silt loam, 0 to 3 percent slopes. It occurs around the heads of drainageways, on slightly beveled slopes above the breaks of low terraces, and around a few depressions or kettle holes on the terraces.

Use and management.—Since most areas of this soil are small, its use is determined largely by that of associated soils. Surface runoff and loss of soil are somewhat greater than on Fox silt loam, 0 to 3 percent slopes, and crop yields are slightly lower. The proportion of the soil used for rotation crops also is lower than on the level phase. The crop rotation commonly followed is corn, soybeans, wheat, and meadow. This rotation is satisfactory where the soil is tilled along the contour. If contour tillage is not used, the rotation should include 2 years of meadow. This can be

accomplished by extending the rotation to 5 years, or by eliminating soybeans where it is desirable to maintain a 4-year rotation.

Genesee Series

The Genesee soils occur on bottom land along all the larger streams and as natural levees bordering these streams. They are well-drained, neutral to slightly alkaline, alluvial soils. The parent materials were washed to their present position from the timbered uplands of the Wisconsin drift region. The soils are associated with the moderately well drained Eel soils of the shallow swales and old meander channels, and with the poorly to very poorly drained Sloan soils of the deeper swales and sloughs.

From November to June, areas of these soils on the bottom land are frequently overflowed. Most of the floods occur during winter. As a result, sandy Genesee soils generally occupy the natural levees and the finer textured Genesee soils the back bottoms. The texture and character of the deposits may change, sometimes radically, during one flood. The degree of change depends on exposure to the current and its carrying power. Loss of soil may also occur as new channels are cut through unprotected streambanks.

Separated as high bottom phases are Genesee soils at slightly higher elevations that are less frequently flooded or that have sufficient gradient for water to drain off quickly.

Genesee silt loam, 0 to 3 percent slopes (Ge) (management subgroup 8A).—This well-drained soil occurs mainly in the large river bottoms, principally the Wabash River valley, and is less extensive in small bottoms. It is the most productive and easiest to manage of the Genesee soils, but cropping is hazardous owing to frequent overflow.

Profile in cultivated area:

0 to 8 inches, yellowish-brown to brown silt loam; weak fine to medium granular structure; friable when moist; organic content medium; neutral to calcareous.
8 to 36 inches, yellowish-brown silt loam; weak coarse granular structure; friable when moist; contains thin lenses or layers of sandy material; neutral to calcareous.
36 inches +, brownish-yellow silt loam, with thin strata of sand, loam, silty clay loam, and an occasional thin gravelly layer; friable when moist; neutral to calcareous.

In wooded and old pasture areas the surface layer to depth of a few inches may be slightly darker in color and higher in organic matter. Partly decomposed twigs, leaves, and other debris may occur in various depositional layers throughout the profile. Local variation in texture is common. Some areas contain variable amounts of sand, and some have loam textures. A few areas are included that have a silty clay loam texture.

Use and management.—Use of this soil is limited by overflow during the winter months. Approximately two-thirds of it is in crops; the rest is in permanent pasture, in forest, or in miscellaneous land uses. Corn, the principal crop, is grown on about half of the total acreage. On some broad bottoms the proportion is considerably higher. Much of the acreage is not fertilized, and crop yields are often reduced by wet weather. Wet spells make cultivation difficult, increase the growth of weeds, and favor the development and spread of crop diseases. Some crops are lost by overflow or occasional frost.

Some farmers seed sweetclover or a grass-legume mixture in wide-spaced corn rows at the last cultivation. This practice is followed to improve supplies of nitrogen and organic matter, to control weeds, and to establish meadow stands without the use of a small-grain nurse crop.

Soybeans are well suited to this soil, but the crop is less profitable than corn. Wheat often is drowned on the level areas. Oats seeding is usually delayed because of late spring floods. Such delays, when followed by hot dry weather in June, often result in reduced yields. Alfalfa and clover produce excellent yields on this soil but are seldom grown because of the flood hazard.

Woodland is largely confined to the narrow bottoms of tributary streams. In these areas it is difficult to use power machinery on the small, irregularly shaped fields. Consequently, forest and permanent pasture is the most prevalent land use. On the broad bottoms, woodland is retained mainly for streambank protection and for prevention of washouts in low areas.

Genesee silt loam, high bottom, 0 to 3 percent slopes (Gf) (management subgroup 8A).—This soil occurs on areas having slight relief that are 2 to 5 feet above the main bottoms. Flooding is less frequent, water drains off readily, and little fresh alluvium is deposited. In profile characteristics this soil is similar to Genesee silt loam, 0 to 3 percent slopes. A few areas are underlain by assorted gravel and sand below a depth of 3 feet. The soil is rarely calcareous and in some places is slightly acid in reaction to a depth of about 18 inches.

Use and management.—This soil is almost entirely cultivated. Less than 10 percent is used for pasture or forestry. Crop rotations are generally followed, but corn and soybeans are the principal crops grown. Oats, wheat, and alfalfa are grown to a greater extent than on Genesee silt loam, 0 to 3 percent slopes.

Genesee loam, 0 to 3 percent slopes (Gc) (management subgroup 8A).—This soil occurs on natural levees along the rivers and smaller streams. About one-third of it is kept in woodland to protect streambanks and areas subject to washouts. Permanent pastures also are extensively used to protect the soil from overflow.

In cultivated areas the 10- to 12-inch surface layer of this soil is grayish-brown to dark grayish-brown friable granular loam. The color is somewhat variable, being a lighter brown near the streams where deposition occurs more frequently. The surface soil is underlain by a yellowish-brown friable loam containing thin layers of sandy material, leaves, twigs, and other debris. The sand content varies with floods; many areas have some fairly loose material on the surface or within the subsoil.

Use and management.—This soil is similar in productivity to Genesee silt loam, 0 to 3 percent slopes, but is used less intensively, particularly on narrow

bottoms. About 40 percent of this soil is cropped, principally to corn. Small grains and alfalfa can be grown with less crop loss than on Genesee silt loam, 0 to 3 percent slopes, because water recedes rapidly from the natural levees and because floods are less frequent along tributary streams of the Wabash River.

Genesee loam, high bottom, 0 to 3 percent slopes (Gd) (management subgroup 8A).—This soil occurs in areas elevated 2 to 5 feet above the regular flood plain and therefore is less susceptible to overflow than Genesee loam, 0 to 3 percent slopes. It has about the same profile characteristics as Genesee loam, 0 to 3 percent slopes. Some areas are slightly darker in color and resemble Ross loam, 0 to 3 percent slopes. A few areas are underlain by gravel and sand at depths of 3 to 4 feet.

Use and management.—This soil is used more intensively than Genesee loam, 0 to 3 percent slopes. About 75 percent of it is cropped. Corn, wheat, soybeans, and alfalfa are the most important crops. Corn is grown on one-third or more of the area. A crop rotation that includes fall-seeded crops can be followed more readily on this soil than on Genesee loam, 0 to 3 percent slopes, because there is less risk of overflow. Management for maintaining productivity requires more attention because this soil receives little soil material through floods. The flood deposits left on other Genesee soils tend to restore productivity.

Genesee fine sandy loam, 0 to 3 percent slopes (Ga) (management subgroup 8A).—This soil occurs on natural levee positions and on washout deposits in the bottom lands along rivers and streams.

The surface soil in cultivated fields is about 12 inches of grayish-brown to pale-brown fine sandy loam. This is underlain by yellowish-brown fine sandy loam that most often extends to a depth of 3 feet or more but is actually extremely variable in depth. Locally, some gravel may be mixed with the sand, and also thin layers of loamy or silty material. The sandy material is moderately coherent and has fair capacity for supplying moisture for crops. On deep sandy areas of this soil, corn and other crops that demand large amounts of water may be damaged during dry periods. The soil is normally mildly alkaline or calcareous and has variable amounts of small shells mixed through it.

Use and management.—Like Genesee loam, 0 to 3 percent slopes, much of this soil is kept in woods and pasture to control erosion, but it is not so intensively used because of its moderate fertility and the somewhat limited moisture supply. Approximately 40 percent of this soil is used for farm crops, the most important of which is corn. Soybeans, wheat, and alfalfa are grown. The soil is well suited to alfalfa. Watermelons and cantaloupes are grown to a limited extent.

Genesee fine sandy loam, high bottom, 0 to 3 percent slopes (Gb) (management subgroup 8A).—This soil is similar to Genesee fine sandy loam, 0 to 3 percent slopes, but occupies slightly higher areas, usually natural levees along old meander channels. Most of these levees occur on the first bottoms of the larger streams. The soil is less likely to be calcareous than the Genesee loam, 0 to 3 percent slopes.

Use and management.—Because of the higher position of this soil, a smaller proportion of it is used for woodland. About two-thirds of it is cropped. Corn, oats, wheat, and alfalfa are the crops most commonly grown. A systematic crop rotation is more needed on this soil than on Genesee silt loam, 0 to 3 percent slopes, because it has lower fertility, less organic matter, and a smaller supply of moisture for plant growth. Management practices should include the return of all available crop residues to the soil and the use of a crop rotation such as corn, wheat, and alfalfa-bromegrass for 2 or 3 years.

Gravel Pits

Gravel pits occur in areas of Fox, Ockley, and other soils that are underlain by loose gravel and sand. The material is used for construction work and roads. Limestone quarries (fig. 12) furnish stone that is

Figure 12.—**Limestone quarry near Delphi; dark-colored streak at top of quarry is Farmington silt loam, 0 to 4 percent slopes, a shallow soil that developed on limestone.**

ground for use as a soil amendment. Limestone also is crushed and used for surfacing roads. Quarries and gravel pits are shown by conventional signs on tne soil map.

Hennepin Series

Hennepin loam, 25 to 65 percent slopes (Ha) (management subgroup 1E).—This soil occurs on the very steep slopes bordering the deeply entrenched Wabash and Tippecanoe river valleys. It is a shallow soil, neutral in reaction. In the deep valleys the relief is as much as 100 feet within short distances (⅛ mile). Surface drainage is very rapid and erosion is severe where forest has been cleared or pasture overgrazed. The original forest cover consisted of oak, hickory, ash, maple, and walnut.

Under forest there is a thin layer of well-decomposed organic matter, neutral in reaction, and overlying very dark grayish-brown loam or gritty silt loam that varies from 6 to 10 inches in depth. The subsoil, from 10 to 14 inches, is yellowish-brown weakly granular heavy silt loam. This is underlain by pale-brown calcareous glacial till.

The soil is neutral to mildly alkaline throughout. Grit, stones, and boulders are on the surface and embedded in the soil.

Variations in profile characteristics are common. On moderately steep slopes and areas associated with the Russell soils, this soil is deeper and tends to have a thicker, slightly heavier subsoil that may be slightly acid. Also, the depth to the calcareous till varies. It is exposed in eroded areas and is 18 inches from the surface where this Hennepin soil grades to the Miami soils.

Use and management.—More than 75 percent of this soil has never been cleared, but much of it is grazed. Because of the steep slopes and the need for a protective cover of plants, most of it should be left in forest. This neutral soil is well suited to bluegrass, but only the less-sloping west- and south-facing slopes should be used for permanent pasture. Even then controlled grazing is necessary, as overgrazing will quickly result in loss of plant cover and cause erosion.

Homer Series

Homer silt loam, 0 to 3 percent slopes (Hb) (management group 5).—This soil occupies the low alluvial terraces in the valleys of the large streams and rivers, where it formed on silty and loamy outwash 30 to 44 inches thick. It is intermediate in position between Fox and Westland soils and is the imperfectly drained member of the catena that includes Fox and Nineveh soils. Relief is nearly level to slightly depressed, and the water table is near the surface most of the time. Consequently, surface runoff and internal drainage are slow. Most areas of this soil are now drained by open ditches. Tile drains fill readily in this soil, so maintenance costs are high. The native vegetation consisted of water-tolerant trees, such as beech, maple, sycamore, ash, elm, and swamp white oak.

Profile in cultivated area:

0 to 7 inches, grayish-brown silt loam; low in organic content; weak medium granular structure; friable when moist and soft when dry; medium to slightly acid; in undisturbed areas the top 2 to 3 inches is very dark grayish brown in color and relatively high in organic matter.

7 to 10 inches, grayish-brown to light brownish-gray silt loam; moderate coarse granular to weak medium platy structure; friable when moist and soft when dry; medium acid.

10 to 15 inches, mottled gray and yellowish-brown heavy silt loam; moderate fine subangular blocky structure; slightly firm when moist and slightly hard when dry; medium to strongly acid.

15 to 38 inches, mottled gray and yellowish-brown clay loam; moderate medium to coarse subangular blocky structure; firm when moist, plastic when wet, and hard when dry; content of gravel and sand increases with depth; medium acid.

38 to 42 inches, dark-brown, mottled with gray, gravelly clay loam; weak coarse to very coarse blocky structure; very firm when moist, sticky and plastic when wet, and very hard when dry; neutral.

42 inches +, pale-brown to light brownish-gray stratified loose gravel and sand; calcareous.

In some localities the surface soil is a loam. The depth to mottling ranges from about 7 to 16 inches, and depths to gravel and sand from about 30 to 44 inches. Included with this soil are a few areas that are underlain by shale or limestone at depths of 36 inches or less. Soils of such areas occur on rock terraces in the Wabash valley, where they are associated with members of the Milton-Millsdale catena. Drainage of these areas is difficult because of their shallow depth to bedrock.

Use and management.—Although the greater part of this soil is cleared, much of it is used for permanent pasture because it is inadequately drained. Corn is the principal crop. Where this soil is a part of fields that are predominantly Westland soil (fig. 13), it is

Figure 13.—Nearly level darker colored Westland silty clay loam in foreground and lighter colored Homer silt loam in middle distance.

used with that soil and corn is grown 2 years in succession. Wheat, clover, and alfalfa give moderate yields where this soil is adequately drained. The crop rotation generally followed is corn, soybeans, wheat, and mixed hay.

Kokomo Series

Kokomo silty clay loam, 0 to 3 percent slopes (Ka) (management subgroup 6A).—This dark-colored very poorly drained soil occupies small areas in the deeper depressions. It occurs in association with the Brook-

ston and Cope soils and, throughout the upland or till plain area, around areas of Carlisle muck. It is formed partly from mineral and organic material that accumulated in the depressions and partly from calcareous glacial till. Natural drainage is very poor, but the greater part of this soil is drained by ditches and tile to permit cropping. In seasons of abnormally high rainfall, water may pond and delay planting of crops or drown out crops already planted. The native vegetation consisted of marsh grasses and ash, elm, soft maple, birch, and other trees that commonly grow where drainage is poor.

Profile in cultivated areas:

0 to 6 inches, very dark gray to black silty clay loam; high in organic matter; weak coarse granular structure; firm when moist and slightly hard when dry; shrinks upon drying, and develops cracks, 1 to 3 inches wide; neutral.
6 to 18 inches, black or very dark gray silty clay loam; high in organic matter; moderate medium subangular blocky structure; firm when moist, plastic when wet, and hard when dry; neutral.
18 to 26 inches, gray heavy silty clay loam to light silty clay; few, faint yellowish-brown mottles in lower part; moderate coarse blocky to weak prismatic structure; very firm when moist, plastic and sticky when wet, and very hard when dry; neutral.
26 to 46 inches, mottled gray and yellowish-brown heavy silty clay loam to light silty clay; moderate very coarse blocky structure; very firm when moist, very plastic when wet, and very hard when dry; neutral to mildly alkaline.
46 inches +, mottled gray and yellow glacial till of loam to light clay loam texture; calcareous.

The total thickness of the first two layers varies from about 15 to 22 inches. In the deeper depressions, some areas have a silty clay surface layer that is very difficult to till. Other areas in the deeper depressions have a thin mucky surface layer and somewhat greater penetration of organic matter into the mineral soil. In areas where this soil is associated with the soils of the Miami catena, the calcareous till occurs at a shallower depth than in those areas where it is associated with the soils of the Russell catena.

Use and management.—Where drainage is adequate, this soil is cropped in about the same way as the Brookston silty clay loam. Corn yields average slightly lower than on the Brookston soil because of partial, and occasionally complete, drowning of the crop in years of excessive rainfall. Oats, wheat, clover, and alfalfa are often severely damaged by winterkilling or by standing water.

Linwood Series

Linwood muck (We) (management group 7).—This soil is associated with Carlisle muck and dark mineral soils, such as Kokomo silty clay loam, 0 to 3 percent slopes. It consists of deposits of muck, 12 to 42 inches thick, that overlie medium-textured mineral material.

The soil is similar to Carlisle muck except in the following ways: (1) Variable amounts of mineral matter from higher land have been mixed with the muck surface layer; (2) the organic material is black to very dark brown in color and well decomposed throughout; and (3) the muck is shallow, less than 42 inches thick, and rests on medium-textured material. The underlying material of this soil, on the till plains, is unassorted glacial till and, on the terraces, outwash plains, and bottoms, consists of stratified clay loam with some silt, sand, and gravel. Artificial drainage is more difficult than for Carlisle muck because ditches or tile must extend into the underlying material. The tile must be placed deep enough to allow for shrinkage of the muck under cultivation and to protect it from being crushed by heavy tillage implements. Tile placed in the substratum, especially in the stratified material, are difficult to keep in position, and thin layers of clay or silt may prevent water from reaching the tile or retard the flow. Crops grown on this soil are similar to those grown on Carlisle muck.

Longlois Series

Longlois silt loam, 0 to 3 percent slopes (Lo) (management subgroup 2A).—This soil occurs on broad, nearly level outwash plains, where it formed on silty and loamy outwash, 42 to 70 inches thick, that overlies calcareous loose gravel and sand. In color and other characteristics the soil is transitional between the Ockley soils of the forest areas and the darker colored prairie or grassland soil of the Wea series found elsewhere in the State. Around kettle holes the soil erodes slightly to produce a dark-colored colluvial soil in the depressions. Areas of this soil were known to early settlers as the "Barrons" because of the scattered stand of bur oak and hickory trees within the prairie grass.

Profile in cultivated area:

0 to 8 inches, very dark grayish-brown to dark-brown silt loam; weak to moderate medium granular structure; friable when moist; medium to slightly acid.
8 to 13 inches, brown to grayish-brown silt loam; moderate coarse granular structure; friable when moist; medium acid.
13 to 20 inches, yellowish-brown to dark-brown silty clay loam; moderate fine subangular blocky structure; firm when moist, slightly plastic when wet, and slightly hard when dry; medium acid.
20 to 52 inches, dark-brown to reddish-brown clay loam; moderate medium to coarse subangular blocky structure; firm when moist and hard when dry; gravel content is variable; medium to strongly acid.
52 to 62 inches, dark-brown to very dark grayish-brown light clay loam or gravelly clay loam; weak coarse to very coarse blocky structure; firm when moist and plastic when wet; neutral.
62 inches +, pale-brown to brownish-yellow loose stratified gravel and sand; calcareous.

Longlois soil is usually lighter colored where it grades to Ockley soils. The silty surface on some areas may represent wind deposits (loess). Depth to calcareous gravel and sand ranges from about 42 to 70 inches.

Use and management.—This soil is almost entirely used for crops. The small areas in which this soil occurs, and the need for increasing the organic-matter content and moisture-holding capacity, have favored a grain-and-livestock system of farming. The crop rotations frequently followed are (1) a 5-year rotation consisting of corn, corn, soybeans, a small grain, and meadow; and (2) a 4-year rotation in which corn is grown only 1 year. Although mixed clover-grass meadows are commonly grown, this soil is better

suited to drought-resistant, deep-rooted crops such as alfalfa. An alfalfa-bromegrass mixture is suitable where meadows are retained 2 years or longer. A suggested crop rotation for this soil is: Corn, soybeans, wheat or oats, and alfalfa-bromegrass for 2 years. Corn may be substituted for the soybeans in this rotation, but a cover crop of rye should be seeded in the first-year corn crop.

Lyles Series

Lyles loam, 0 to 3 percent slopes (Lb) (management subgroup 6B).—This is a dark-colored, poorly to very poorly drained depressional soil of the bottom lands. It is associated with the light-colored, sandy and excessively drained Oaktown soil. It has developed largely from water-assorted stratified sands, but some colluvial material has washed in from the associated sand dunes. A swamp-forest cover and ponded drainage prevailed when the soil was brought under cultivation.

Profile in cultivated area:

0 to 8 inches, very dark grayish-brown loam; organic content high; moderate medium granular structure; friable when moist; slightly acid to neutral.
8 to 18 inches, very dark loam to light sandy clay loam; weak coarse granular structure; friable to slightly firm; slightly acid to neutral.
18 to 30 inches, mottled gray and yellowish-brown loam or sandy clay loam; firm when moist and slightly plastic when wet; neutral to mildly alkaline.
30 inches +, mottled gray and yellowish-brown fine sand with lenses or layers of loamy material; neutral to alkaline; calcareous at depths of 4 to 6 feet.

Where this soil grades into the associated Oaktown, it includes some areas that are lighter in color and lower in organic matter. Internal drainage in some parts of the depressional areas is moderately well established, resulting in a brown subsoil free of mottles.

Use and management.—This soil is normally used for corn and soybeans. Where drainage is adequate the crop rotation generally followed is corn, soybeans, wheat, and meadow.

Metea Series

Metea fine sandy loam, 3 to 8 percent slopes (Ma) (management group 3).—This light-colored somewhat excessively drained soil is intermediate in characteristics between the sandy Coloma soils, not mapped in this county, and the sandy members of the Miami series, both of which are extensive on the till plain immediately north of the Carroll-White county line. Areas occupied by this soil were originally timbered with oak, hickory, sugar maple, and walnut.

Profile in cultivated area:

0 to 12 inches, grayish-brown fine sandy loam; organic-matter content low; weak medium granular structure; very friable when moist; medium to slightly acid.
12 to 24 inches, yellowish-brown to brown fine sandy loam to loamy fine sand; very weak coarse granular structure; very friable; medium to strongly acid.
24 to 48 inches, yellowish-brown to dark yellowish-brown sandy clay loam to clay loam; grades to loam in lower part; moderate medium subangular blocky structure; firm; medium acid.
48 inches +, pale-brown or light yellowish-brown light loam to heavy sandy loam till; calcareous.

The total thickness of the upper two sandy layers varies from about 20 to 40 inches. A few areas have a loam surface soil. In areas where the sandy surface soil has its minimum thickness, the subsoil is usually finer textured and resembles that of the Miami silt loams. Also included are more sandy areas on or near the outwash plain. These areas, which resemble areas of soil of the Coloma series, consist of deep, loose sand, relatively free of gravel, and slightly cemented in the subsoil. Such areas probably are underlain by water-assorted sand.

Use and management.—Most of this soil has been cleared and is now cropped. The principal crops are corn, wheat, and mixed meadow (chiefly alfalfa). Crop yields are relatively low, particularly of those crops likely to be injured by drought. Corn may be a near failure in years of prolonged drought. Rye is better adapted to the low nitrogen content of this soil than wheat. Alfalfa and other deep-rooted legumes are better suited to the droughty soil than red clover and shallow-rooted legumes. Practices needed to improve the soil include the use of winter cover crops and green-manure crops and the use of crop rotations containing a greater proportion of legume-grass mixtures, such as alfalfa-bromegrass. A suitable 4-year crop rotation is corn, wheat or rye, and a meadow mixture of alfalfa and bromegrass for 2 years.

Miami Series

Miami soils are well-drained soils occupying low knolls on the till plain and sloping areas around drainageways. They are associated with the imperfectly drained Crosby and the very poorly drained Brookston and Kokomo soils. The parent material consists of medium-textured, highly calcareous glacial till of Wisconsin age. These soils were developed under a mixed deciduous forest consisting of sugar maple, beech, ash, elm, walnut, hickory, and white oak. The soils, therefore, are light in color and naturally low in organic matter.

Miami silt loam, 3 to 8 percent slopes (Mb) (management subgroup 1A).—This well-drained soil occupies low knolls and moraine ridges on the till plain and sloping areas around drainageways. Local relief ranges from 10 to 20 feet. The dominant slope is about 6 percent. Surface runoff is moderate to rapid, and internal drainage is moderate.

Profile in cultivated area:

0 to 7 inches, brown to grayish-brown silt loam; moderate to weak fine granular structure; friable when moist; usually contains appreciable sand and small rock fragments; medium to slightly acid.
7 to 10 inches, brown to light yellowish-brown silt loam; moderate thin platy to coarse granular structure; friable when moist; medium acid.
10 to 16 inches, yellowish-brown light silty clay loam; moderate fine subangular blocky structure; slightly firm when moist; medium to strongly acid.
16 to 28 inches, brown to yellowish-brown silty clay loam to clay loam; moderate to strong medium and coarse subangular blocky structure; firm when moist and hard when dry; medium to strongly acid.

28 to 33 inches, dark-brown to very dark grayish-brown clay loam; moderate coarse subangular blocky structure; firm when moist, sticky when wet, and hard when dry; slightly acid to neutral.
33 inches +, light yellowish-brown loam to light clay loam glacial till; calcareous.

Depth to calcareous till varies from about 24 to 42 inches and averages about 33 inches. Some areas of this soil, those associated with areas of Russell soils, have a relatively smooth silty surface soil and are leached of carbonates to slightly greater depths. A few areas are included that have nearly level relief (less than 3 percent slopes). In these areas, internal-drainage conditions are improved by the more permeable sandy material within the till, which is usually at depths of 4 feet or more.

Use and management.—About 85 percent of this soil is under cultivation. A grain-and-livestock system of farming is practiced in which a crop rotation of corn, wheat, and mixed meadow is commonly followed. Legumes, such as red clover, sweetclover, and alfalfa, are well suited to this soil if its acidity is corrected by liming. Alfalfa is extensively grown in the crop rotations, particularly in areas susceptible to erosion. Because soil erosion is the greatest problem, conservation practices should be followed. A suggested 4-year crop rotation is corn, a small grain, and mixed meadow (such as alfalfa-bromegrass) for 2 years.

Miami silt loam, 3 to 8 percent slopes, eroded (Mc) (management subgroup 1B).—This soil has slightly greater slopes than the uneroded phase. Much of the surface soil has been lost because of more intensive use. The subsoil is exposed in some areas. The present surface soil ranges from grayish-brown heavy silt loam to yellowish-brown silty clay loam. The silty clay loam surface layer exists where erosion has been more severe. Small areas are included in which the former surface soil and upper subsoil have been eroded away and the heavier textured subsoil is exposed. Shallow gullies form readily in these eroded areas.

Use and management.—A higher proportion of corn, soybeans, and other row crops are grown on this eroded soil than on the uneroded phase. Although many of the more seriously eroded areas are used as permanent bluegrass pastures, stands are poor, the carrying capacity for stock is low, and little effort is being made to improve them. A suggested rotation is corn, wheat, and a mixture of alfalfa and bromegrass for 2 years.

Miami silt loam, 8 to 12 percent slopes, eroded (Md) (management subgroup 1C).—This soil differs from Miami silt loam, 3 to 8 percent slopes, eroded phase, chiefly in slope. A few included areas have lost all the surface soil and part of the subsoil through erosion. Gullies are present, but usually they can be filled by plowing or tillage. Also included are a few wooded areas having normal silt loam surface soil, 10 to 12 inches in depth.

Use and management.—Most of the formerly cultivated areas on this soil have reverted to permanent pasture or are now idle. Loss of soil and rapid runoff limit the fertility and moisture supply. The soil is best suited to pasture and forest. Most of the permanent pastures respond well to renovation. Some of the more severely eroded areas are being reforested. On less severely eroded areas a rotation consisting of a small grain followed by alfalfa-bromegrass meadow for 3 years or more is suitable. A suitable rotation using contour tillage and winter cover crops is corn, wheat, and alfalfa-bromegrass meadow for 2 years or more.

Miami silt loam, 12 to 18 percent slopes, eroded (Me) (management subgroup 1D).—This soil differs from the other eroded phases in having greater slopes and greater variability in its profile. The variation depends upon the amount of soil lost through erosion. Some areas have gullies 1 to 3 feet or more in depth. Small areas, usually wooded, are included that have the normal grayish-brown silt loam surface soil.

Use and management.—This soil is best suited to longtime meadow, permanent pasture, and forest. It is used, to a limited extent, for grain and rotation crops. Deep-rooted legumes, such as alfalfa, are better suited to the limited moisture supply. When combined with grass, alfalfa provides an effective cover for erosion control.

Millsdale Series

Millsdale silty clay loam, 0 to 3 percent slopes (Mf) (management subgroup 6A).—This soil developed from shallow outwash materials that were deposited on limestone benches or rock terraces. It occurs in depressions where very poor drainage prevailed. At Delphi, some of the rock terraces consist of brown shale that is acid in reaction.

The soils are nearly level, but there is a very slight slope downstream and into the lower parts of the long swales or old glacial channels. Since there is little surface runoff, ponds form in the deeper depressions after rains. Internal drainage is slow. Seepage water from higher areas moves very slowly through the bedrock, particularly through the shale.

The original vegetation consisted of swamp timber, marsh grasses, and sedges. Most areas are now cleared, artificially drained, and under cultivation. Drainage is difficult because good outlets cannot be obtained. Because the soil is shallow it is often necessary to cut ditches through the rock or lay tile in the rock in order to get adequate fall.

This soil is the very poorly drained member of the catena that includes the well-drained Milton soil. It is also associated with Carlisle muck.

Profile in cultivated areas:

0 to 7 inches, very dark grayish-brown to black silty clay loam; high in organic matter; moderate coarse granular structure; firm when moist and slightly hard when dry; neutral.
7 to 17 inches, very dark gray to black silty clay loam to silty clay; organic-matter content high in upper part and diminishes with depth; moderate coarse to very coarse blocky structure; very firm when moist, plastic when wet, and hard when dry; neutral to mildly alkaline.
17 to 22 inches, gray silty clay loam to light silty clay, weakly to strongly mottled with yellowish brown and brownish yellow; weak very coarse blocky structure; very firm when moist, plastic when wet, and very hard when dry; contains variable amounts of limestone or shale and sandstone fragments; neutral.

22 inches +, partially weathered gray limestone or brown shale and sandstone with thin films and layers of silty clay between the rock fragments; grades to bedrock.

Drainage is poorer where the Millsdale soil is associated with Carlisle muck. In these areas the surface soil is darker and has a higher organic-matter level, and the subsoil is gray and more impervious. The depth to unweathered rock ranges from about 20 to 48 inches.

Use and management.—This highly productive soil is well suited to corn and soybeans where artificial drainage can be provided. Most of this soil has been cleared, but about 25 percent of it is now used for permanent pasture. Where drainage is adequate, a 4-year crop rotation of corn, soybeans, wheat, and mixed hay is normally followed. Wet areas, where cultivated, are used mainly for corn and soybeans. Fall-seeded small grains and clover frequently are damaged by winterkilling. Oats frequently cannot be seeded early because of excessive moisture.

Milton Series

Milton silt loam, 0 to 5 percent slopes (Mg) (management subgroup 1A).—This well-drained soil has developed in shallow deposits of Wisconsin drift on limestone rock terraces. It resembles the Fox soils but has a smaller amount of gravelly material in its profile and limestone fragments are present instead of limy gravel. A few areas around Delphi are underlain by acid, brown shale instead of limestone. Surface runoff is moderate to slow, depending on the slope. Internal drainage varies according to the permeability of the drift and underlying geological materials. The underlying shale is less permeable than the limestone.

Profile in a cultivated area:

0 to 7 inches, brown gritty silt loam; weak medium granular structure; friable when moist; medium to slightly acid.
7 to 10 inches, grayish-brown to brown silt loam; weak thin platy to coarse granular structure; friable when moist; medium acid.
10 to 15 inches, yellowish-brown light silty clay loam; moderate fine subangular blocky structure; firm when moist and slightly hard when dry; medium acid.
15 to 25 inches, yellowish-brown to strong-brown clay loam; moderate medium and coarse subangular blocky structure; firm when moist and hard when dry; medium acid.
25 inches +, partially weathered limestone clay with a thin overburden of gravelly and sandy material; this grades into solid bedrock, usually limestone, but shale and sandstone bedrock are present in about one-third of this acreage; medium acid.

The soil profile varies because different kinds and amounts of glacial material have been deposited over the bedrock. Where glacial deposits are shallow, less gravel and sand are usually present and the soil is likely to be browner in color and less acid in reaction. Where the underlying material consists of the soft, easily broken, brown shale, variable amounts of shale fragments occur throughout the soil but are most plentiful immediately above the shale bedrock. Where the underlying material is limestone, the weathering material may be higher in clay and more plastic.

Use and management.—Approximately 75 percent of this soil has been cleared, and about 50 percent of it is used for crops. Corn is the principal crop, but the soil is better suited to permanent pasture, meadow crops, small grains, and soybeans. A 4-year rotation of corn, soybeans, a small grain, and mixed meadow is generally followed.

Monitor Series

Monitor silt loam, 0 to 3 percent slopes (Mh) (management group 5).—This imperfectly drained soil occurs on nearly level outwash plains and in shallow depressions in areas formerly covered by prairie grasses. It is the imperfectly drained member of the catena that includes the well-drained Longlois soil and the very poorly drained Westland soils. Natural drainage is limited by the fairly high water table that normally exists on level plains and in depressions. Where outlets are present the water moves freely through the underlying gravel and sand. Prairie grass covered most of the soil during its early development, but at the time of settlement it was covered with oak-hickory forest.

Profile in cultivated areas:

0 to 8 inches, very dark grayish-brown silt loam; organic-matter content fairly high; moderate medium granular structure; friable when moist; medium to slightly acid.
8 to 13 inches, grayish-brown silt loam; weak thin platy to coarse granular structure; friable; medium acid.
13 to 22 inches, mottled gray and yellowish-brown silty clay loam; moderate medium to fine subangular blocky structure; firm when moist; medium acid.
22 to 38 inches, mottled gray, yellowish-brown, and brownish-yellow clay loam; moderate coarse subangular blocky structure; firm when moist; medium acid.
38 to 55 inches, mottled gray and yellowish-brown sandy clay loam, with strata (thin layers) of loamy sand; weak coarse blocky structure; firm to friable; medium acid.
55 to 60 inches, dark-brown to dark yellowish-brown clay loam to heavy loam; weak coarse blocky structure; firm when moist and plastic when wet; slightly acid to neutral.
60 inches +, pale-brown to gray loose stratified fine gravel and sand; calcareous.

Depth to mottling ranges from about 6 to 16 inches, and the depth to loose gravel and sand, from about 42 to 66 inches. Near the White County line, about 4 miles northeast of Patton, glacial till underlies calcareous sand at depths of 7 to 10 feet. In these areas the surface soil is darker and deeper. Though they are not shown on the map, small areas of this soil can be found in kettle holes about 2 miles west-northwest of Delphi. In these areas, this soil overlies deep gravel and sand deposits. These positions have been silted-in somewhat because of erosion on the adjoining slopes, but drainage is fair and mottling, which is less noticeable, occurs at a greater depth.

Use and management.—This soil is well suited to corn and soybeans, but all crops common in the region may be grown. On inadequately drained areas there is a higher proportion of meadow and permanent pasture. Adequately drained areas are intensively used, and crop yields are equal to or slightly higher than those on the associated Longlois soil.

Nineveh Series

Nineveh loam, 0 to 3 percent slopes (Na) (management subgroup 2A).—This soil has developed from loamy outwash, 25 to 40 inches thick, overlying highly calcareous gravel and sand deposits of the Wisconsin glacial period. It occurs on high bottoms and low terraces and is associated with the Fox soils. Internal drainage is medium to rapid. The native vegetation consisted of hardwood trees, chiefly hackberry, ash, walnut, and sugar maple.

Profile in cultivated areas:

0 to 10 inches, dark-brown to very dark grayish-brown loam; weak medium granular structure; friable when moist; neutral.
10 to 18 inches, brown to dark-brown loam to light clay loam; weak fine subangular blocky structure; slightly firm; contains some small pebbles; neutral.
18 to 28 inches, strong-brown to reddish-brown gravelly clay loam; moderate to weak medium subangular blocky structure; firm when moist, plastic and sticky when wet, and hard when dry; neutral.
28 to 34 inches, dark-brown to very dark grayish-brown gravelly clay loam; firm when moist and plastic and sticky when wet; neutral.
34 inches +, pale-brown loose stratified gravel and sand; calcareous.

The surface layer is lighter colored in areas where this soil is transitional to Fox soils. These lighter colored areas are slightly acid. A few areas have cobbly fragments, 6 to 10 inches in diameter, on the surface and throughout the profile. Depth to loose gravel and sand ranges from about 25 to 40 inches.

Use and management.—Less than 50 percent of this soil is cropped. The principal crops are small grains and hay. Corn and oats are not suitable because the soil has low moisture-holding capacity. Crop rotations and management practices are similar to those on Fox loams, but the organic-matter content and moisture supply require more attention.

Oaktown Series

Oaktown loamy fine sand, 3 to 10 percent slopes (Oa) (management group 4).—The Oaktown soil is a light-colored sandy soil, developed from wind-deposited fine sands. The soil is undulating to rolling—a series of dunes, troughs, and small flat areas. This soil is excessively drained and the principal member of the catena that includes the dark-colored, poorly drained Lyles loam of the depressional areas. It was developed from uniformly wind-assorted fine sand that was blown largely from river bottoms during the retreat of the glacier. The fine sand was deposited on adjacent river terraces, usually on the eastern side of the valley. These sand deposits vary from 4 to 10 feet or more in depth and are neutral to slightly calcareous. Under the dune sands are water-deposited gravel and sand that further contribute to the very rapid internal drainage. Deciduous hardwood forest, largely oak and hickory, had covered the dunes before settlement of the area began.

Profile in cultivated areas:

0 to 6 inches, brown loamy fine sand; low in organic matter; very weak medium granular structure; very friable when moist; medium to slightly acid.
6 to 12 inches grayish-brown or light yellowish-brown loamy fine sand; very weak coarse granular structure; nearly loose; medium acid.
12 to 30 inches, pale-brown or yellowish-brown loamy fine sand; nearly loose; medium acid.
30 to 75 inches, brownish-yellow loamy fine sand, with thin and often discontinuous bands and lenses of yellowish-brown heavy loamy fine sand to light fine sandy loam; the bands are very friable, and the brownish-yellow loamy fine sand is loose; medium acid in upper part, with a gradual change to slightly acid in lower part.
75 inches +, pale-brown to light brownish-gray loose fine sand; dominantly neutral, but calcareous in some areas.

The depth to the fine-textured bands, the frequency with which they occur, their thickness, and their clay content are variable.

Many small areas having stronger slopes are included with this soil. Also, in depressional areas internal drainage is often well established because there are underlying beds of gravel and sand that favor percolation of water. The surface soil in these areas is slightly darker and deeper and contains more organic matter. In such areas the soils frequently grade into the darker, more poorly drained Lyles loam. Also included are small areas that have subsoils ranging from loam to sandy clay loam. Wind erosion on exposed slopes frequently results in loss of considerable amounts of surface soil. Small areas of this soil in the Tippecanoe River valley often are not so well sorted as those north of Delphi.

Use and management.—Most of this soil has been cleared and is now cultivated. A livestock system of farming is usually followed, but the soil is well suited to special crops. Corn, soybeans, and wheat—the principal grain crops—are usually grown in a rotation that includes grass-legume meadow for 1 or 2 years. Red clover generally is sown in the grass-legume mixture, but alfalfa and sweetclover are better suited because they are less susceptible to drought.

Ockley Series

The Ockley soils have developed from silty and loamy outwash, 42 to 70 inches thick, that overlies calcareous sand and gravel of Wisconsin age. They occur on broad outwash plains and high terraces, often in positions only a little lower than the bordering glacial till plain. In location, they are between the Russell soils of the till plain and the Fox soils of the lower terraces. Water readily penetrates the surface soil and moves freely through the subsoil because the substratum is porous. Internal drainage ranges from medium to rapid, depending on depth of soil and amount of gravel. The Ockley soils are the well-drained members of the catena that includes the imperfectly drained Sleeth and the very poorly drained Westland and Abington soils.

Although largely cleared and cultivated, these soils originally had a heavy stand of oak, sugar maple, walnut, and beech.

Ockley silt loam, 0 to 3 percent slopes (Oe) (management subgroup 2A).—This soil has developed on glacial stream deposits of calcareous sand and gravel. Since the soil materials are naturally well drained and occupy large level areas, the soil is subject to very

little erosion. This soil occurs on more than 10 percent of the land area in the county.

Profile in a cultivated area:

0 to 7 inches, brown smooth silt loam; moderate to weak medium granular structure; friable when moist; medium to slightly acid.
7 to 12 inches, yellowish-brown or brown silt loam; moderate thin platy or coarse granular structure; friable; medium acid.
12 to 18 inches, yellowish-brown to dark yellowish-brown heavy silt loam to light silty clay loam; moderate fine subangular blocky structure; slightly firm; medium to strongly acid.
18 to 39 inches, strong-brown to reddish-brown silty clay loam or clay loam; moderate medium to coarse angular blocky structure; firm when moist, moderately plastic when wet, and hard when dry; medium to strongly acid.
39 to 55 inches, yellowish-brown to reddish-brown sandy clay loam to heavy sandy loam; moderate coarse subangular blocky structure; firm when moist; medium acid.
55 to 63 inches, dark-brown to very dark grayish-brown clay loam to gravelly or sandy clay loam; considerably darker than layer above; weak coarse to very coarse blocky structure; firm when moist and sticky when wet; slightly acid to neutral.
63 inches +, pale-brown or light brownish-gray stratified fine gravel and sand; loose; calcareous.

The surface soil is somewhat darker and deeper where it grades to Longlois silt loam, 0 to 3 percent slopes. The sand and gravel is often shallow and in places completely leached of free lime. In places the assorted material is underlain at depths of 7 to 10 feet by compact glacial till similar to that under the Russell and Miami soils. Such areas usually have a more favorable moisture supply because drainage is slower than in areas where this soil overlies loose deposits of gravel and sand. The dark-brown layer at the contact with limy gravel also varies greatly in color, stickiness, and thickness. Wedge-shaped areas of this material occasionally extend deep into the gravel.

Use and management.—Since this soil occurs on large level areas, is uniform in character, and is above average in fertility, nearly all of it is cropped. Grain-and-livestock farming is practiced, largely because drought-resistant small grains and meadow crops (particularly alfalfa) use the moisture more effectively and improve the moisture-holding capacity of the soil. Corn, the principal crop, produces fairly well in normal years but much better in years of favorable moisture supply. Wheat is well suited to this naturally well-drained soil, and there is little winterkilling. Oats produce well if seeded early in the spring to take advantage of adequate moisture. On meadows, mixed seedings of red clover and timothy are preferable to red clover alone because the timothy will provide feed if the red clover is damaged by drought. Alfalfa is best suited to this soil because it produces large quantities of high-quality hay and utilizes the moisture supply more effectively than plants with shallower root systems. Alfalfa should be seeded in a mixture with bromegrass or timothy, particularly if the meadow is to remain 2 years or more.

Ockley silt loam, 3 to 8 percent slopes (Of) (management subgroup 2B).—This soil occurs around drainageways and shallow kettle holes on outwash plains and terraces. It is similar to Ockley silt loam, 0 to 3 percent slopes, in all respects except slope.

Use and management.—Surface drainage on this soil is rapid enough to cause serious erosion under intensive farming, particularly if conservation practices are not followed. The slopes usually are short and border streams. Erosion can be controlled on these slopes by contour tillage. Areas around kettle holes do not lend themselves readily to contour tillage; consequently, it may be necessary to adopt longer crop rotations or use such areas for permanent pasture. By keeping a higher proportion of this phase in timber or using it for pasture, farmers have preserved much of it from serious erosion.

Ockley silt loam, 3 to 8 percent slopes, eroded (Og) (management subgroup 2C).—This soil is similar to Ockley silt loam, 0 to 3 percent slopes, but slopes are greater and the surface soil varies from grayish-brown heavy silt loam to yellowish-brown silty clay loam. Because of the excessive growing of clean-tilled crops on this soil, it is severely eroded in places and is susceptible to further erosion. In some included areas erosion has removed the surface soil and upper subsoil and exposed the heavier textured subsoil.

Use and management.—The proportion of row crops is nearly as high on this soil as on Ockley silt loam, 0 to 3 percent slopes. Because of their lower moisture requirements, soybeans, wheat, rye, and grass-legume mixtures are better suited to the soil than corn, oats, and red clover. Permanent bluegrass pastures are often thin, weedy, and low in carrying capacity. Row crops should not be grown in succession on this soil without terracing or stripcropping. It is preferable to retain meadows for 2 years or more.

Ockley loam, 0 to 3 percent slopes (Ob) (management subgroup 2A).—This soil type differs from Ockley silt loam, 0 to 3 percent slopes, in having a loam surface soil and a dominantly clay loam to sandy clay loam subsoil. About 5 miles north of Delphi there is an area that has a high proportion of very fine sand in the surface soil, but the subsoil is similar to that just described. Several small areas are included that have more sandy surface soil and less clayey subsoil.

Use and management.—Crops grown on this soil are similar to those grown on Ockley silt loam, 0 to 3 percent slopes, but yields are slightly lower because this soil has a lighter texture. Since the soil drys quickly and warms rapidly in spring, oats can often be seeded early enough to escape serious drought damage. Alfalfa is better suited to the moisture conditions than red clover. Because the soil tends to be sandy, there is likely to be a deficiency in potassium.

Ockley loam, 3 to 8 percent slopes (Oc) (management subgroup 2B).—This soil occurs principally on upper slopes bordering drainageways and in small areas around kettle holes. The soil is similar to Ockley loam, 0 to 3 percent slopes, but slopes are stronger, and small areas are included where erosion has removed a considerable part of the surface soil.

Use and management.—Farmers have protected this soil to some extent by less intensive cultivation. Areas cultivated should be protected by using long rotations that include legumes and winter cover crops. Contour tillage and stripcropping are also needed.

Ockley loam, 3 to 8 percent slopes, eroded (Od) (management subgroup 2C).—This soil is similar to Ockley loam, 3 to 8 percent slopes, but intensive cultivation has resulted in severe erosion and increased the susceptibility of this soil to erosion. The surface soil ranges from grayish-brown heavy loam to yellowish-brown clay loam. In some areas the surface soil and upper subsoil have been removed and the heavier textured subsoil is exposed.

Use and management.—This soil has been cultivated nearly as intensively as Ockley loam, 0 to 3 percent slopes, but without conservation methods. Wheat and mixed meadow crops, such as a mixture of alfalfa and bromegrass, are best suited to this soil.

Rodman Series

Rodman gravelly loam, 25 to 60 percent slopes (Ra) (management subgroup 1E).—This soil occurs on the steep breaks or escarpments of terraces. It is associated principally with the Ockley soils of the higher terraces, but it is also associated with Fox soils of the lower terraces. Because slopes are steep, water runs off rapidly and carries so much soil material with it that the soil remains shallow. The forests consist largely of oak, hickory, and walnut.

Profile under forest cover:

¼ to 0 inch, surface layer consisting of well-decomposed leaf mold and other organic material.
0 to 10 inches, dark-brown to very dark grayish-brown gravelly loam; neutral.
10 inches +, dark-brown to yellowish-brown very gravelly loam, neutral in reaction, and underlain by calcareous stratified gravel and sand.

In some of the more gentle sloping areas a thin layer of heavy gravelly loam to light gravelly clay loam has developed above the loose gravel and sand. Some areas have lost a large part of the dark-colored surface soil through erosion. In some areas, loamy glacial till is present on the slopes, especially the slopes of the higher terraces. These areas were not of sufficient size to be separated as Hennepin loam, 25 to 65 percent slopes.

Use and management.—Forest has been retained on about 50 percent of this soil. About 10 percent of it is used for crops, and the rest is in permanent pasture. Kentucky bluegrass produces a lush growth during spring when the moisture supply is adequate, but the pastures have a low carrying capacity during summer.

Ross Series

These dark-colored, well-drained soils occur on high bottoms in river valleys, where they are associated with the Genesee and Eel soils. They were formed from sediments washed from the timbered uplands of the Wisconsin drift region. Little deposition is now occurring because the high bottoms are seldom flooded.

Ross silty clay loam, 0 to 3 percent slopes (Rd) (management subgroup 8A).—The surface layer of this soil, about 8 inches thick, is a very dark-brown silty clay loam that dries to a dark grayish brown. The organic-matter content is high. This surface layer is friable when properly tilled but forms hard clods if worked when wet. The subsurface layer, extending from about 8 inches down to 20 inches, is similar to the surface soil in color but is somewhat heavier textured and more compact. Below the subsurface layer is the subsoil, a brown to yellowish-brown silty clay loam. The subsoil has less organic matter than the layers above, and it sometimes contains thin layers of silty or loamy material.

The soil is neutral throughout. In areas transitional to Genesee soils, its surface soil is lighter colored and shallower.

Use and management.—Although originally timbered, this soil is now almost entirely under cultivation. Corn, the principal crop, is grown on about 66 percent of the total acreage. The soil yields somewhat less than the associated Genesee soils, partly because it has been used continuously for corn and partly because only limited quantities of fresh sediments are deposited on it. The poor physical condition and limited moisture supply of this soil, caused by its high clay content, have favored a crop rotation that includes soybeans, a small grain (generally wheat), and legume meadow. Alfalfa is the principal meadow crop, but sweetclover is sometimes seeded to improve the soil.

Ross silt loam, 0 to 3 percent slopes (Rc) (management subgroup 8A).—The surface soil is very dark grayish-brown friable silt loam that is high in organic matter. It extends to depths of 15 to 20 inches or more before it grades to a friable yellowish-brown silt loam. The soil is usually neutral in reaction but may be slightly calcareous at depths of 4 feet or more. Its tilth is more favorable than that of the Ross silty clay loam, 0 to 3 percent slopes.

Use and management.—Since this soil occurs in smaller areas, it is not so completely cropped as the Ross silty clay loam, 0 to 3 percent slopes. Use and management are similar to those on the heavier Ross soil.

Ross loam, 0 to 3 percent slopes (Rb) (management subgroup 8A).—This soil has an open, permeable structure and is well aerated. Decomposition of organic matter takes place more rapidly than on the other Ross soils, and the soil is somewhat lighter colored. The surface soil, a very dark grayish-brown loam, grades to a yellowish-brown loam subsoil at depths of about 15 to 20 inches. Variable amounts of sand are present in the surface soil and occur as thin layers throughout the profile. In a few places the surface soil has a fine sandy loam texture.

Use and management.—Corn is the main crop, but small grains and meadow crops, chiefly alfalfa and red clover, are more extensively grown than on the heavier Ross soils. In comparison with the heavier Ross soils, this soil yields less and requires more attention to increasing organic-matter content, moisture-supplying capacity and fertility. A fertilizer high in potassium is needed to meet the requirements of such crops as alfalfa. A suitable 5-year rotation is corn, soybeans or corn, a small grain, and a mixed grass-alfalfa meadow for 2 years.

Russell Series

Russell soils have developed from silt (loess) over weathered till of Wisconsin age. Calcareous loam till occurs at depths of about 42 to 70 inches. These soils are the well-drained soils of the catena that includes the imperfectly drained Fincastle and the poorly to very poorly drained Cope, Brookston, and Kokomo soils. Russell soils resemble Miami soils in many respects but differ in having siltier surface soils, relatively grit-free upper subsoils to variable depths, stronger acidity, and a greater depth of acid soil above the calcareous till.

Russell silt loam, 3 to 8 percent slopes (Rf) (management subgroup 1A).—This well-drained soil has sufficient slope to provide adequate surface runoff. The prevailing slope is about 5 percent. Local relief rarely exceeds 10 to 20 feet. The soil occurs throughout the upland. Small areas are on gently undulating knolls and ridges on the broad divides between streams. Such areas slope in all directions to the nearly level till plain.

Profile in cultivated area:

0 to 7 inches, brown to grayish-brown smooth silt loam; low in organic matter; moderate to weak medium granular structure; friable when moist; medium to slightly acid; in undisturbed wooded areas surface 2 to 3 inches is very dark brown or very dark gray silt loam, relatively high in organic matter.

7 to 11 inches, pale-brown to brown smooth silt loam; weak fine platy or moderate coarse granular structure; friable; upper 2 or 3 inches is compact in some areas; medium acid.

11 to 18 inches, yellowish-brown to dark-brown smooth light silty clay loam; moderate to strong fine subangular blocky structure; slightly firm when moist; medium to strongly acid.

18 to 28 inches, dark-brown or dark yellowish-brown smooth silty clay loam; moderate to strong medium blocky structure; firm when moist and slightly hard when dry; strongly acid to medium acid.

28 to 54 inches, dark yellowish-brown to dark-brown clay loam; moderate coarse subangular blocky structure; firm when moist and hard when dry; contains considerable grit and small rock fragments; medium to strongly acid in upper part but grades to slightly acid or neutral in the lower few inches.

54 inches +, brown or pale-brown loam to light clay loam glacial till; calcareous.

The smooth silty mantle varies in thickness from several inches to as much as 40 inches. A few small areas, principally north of Lockport, contain considerable fine sand. Many small areas are included where considerable surface soil has been lost by erosion.

Use and management.—Most of this soil has been cleared of timber and is now used for crops or pasture. A grain-and-livestock system of farming is generally followed. Two rotations are in common use: A 4-year rotation of corn, soybeans, wheat, and meadow and a 3-year rotation of corn, oats or wheat, and meadow.

Corn, the principal crop, usually follows meadow in the rotation. A common practice is to manure areas to be planted to corn. Use of commercial fertilizers is increasing, but lack of sufficient nitrogen may still prevent high yields. Soybeans are not well suited to follow corn on this sloping soil unless they are planted on the contour. Wheat usually follows either soybeans or oats in the rotation, but a small part of the wheat is seeded in standing corn or, after early harvesting, in the corn stubble. A topdressing of manure during winter (up to 2 tons per acre) reduces winterkilling and soil erosion. Nitrogen deficiency is readily corrected by topdressing early in spring with 25 pounds or more per acre of soluble nitrogen. This is the amount contained in 125 pounds of ammonium sulfate or 80 pounds of ammonium nitrate. Oats are seeded early in spring in corn stubble that has been well disked. Although oats received little fertilizer in the past, use of a complete fertilizer is increasing. The crop responds well to nitrogen in the fertilizer mixture.

Because of soil acidity and dry-weather injury, mixtures of grass and legumes—principally of red clover, alfalfa, and timothy—are most commonly seeded. The soil is well suited to sweetclover and alfalfa when adequately limed. Sweetclover is seeded principally for pasture and soil improvement. Alfalfa is usually seeded as a pure stand in small tracts that are to stand several years. For meadows to stand 2 years or more, a mixed seeding of alfalfa and bromegrass is better than alfalfa alone because it provides heavier yields and more uniform growth through the season. Insects, disease, and low fertility, particularly potassium deficiency, frequently shorten the life of the alfalfa.

Russell silt loam, 3 to 8 percent slopes, eroded (Rg) (management subgroup 1B).—This soil occurs on the higher and more sloping knolls, generally bordering shallow drainageways or on the upper slopes of the deeper valleys. Erosion, therefore, is more severe than on Russell silt loam, 3 to 8 percent slopes. Some small areas having slopes greater than 8 percent are included.

The surface soil varies from a grayish-brown smooth silt loam to a yellowish-brown silty clay loam, depending upon the amount of erosion. In numerous small areas where erosion is more severe, the yellowish-brown upper subsoil is exposed. Mixing of surface soil and subsoil during tillage makes the plow soil more clayey and less permeable than the original surface layer. Rill erosion is common along wheel tracks where cultivation has been up and down the slope. Gullies, 1 to 3 feet in depth, sometimes develop. These gullies cannot be crossed with tillage implements, but usually are plowed in.

Use and management.—Approximately 95 percent of this soil is under cultivation. It is more intensively cropped than Russell silt loam, 3 to 8 percent slopes, particularly to corn and soybeans. These crops usually are grown in successive years. This practice rapidly depletes the organic supply and increases susceptibility to erosion.

Crop yields are lower than on Russell silt loam, 3 to 8 percent slopes, and much of the permanent pasture has a relatively low carrying capacity.

Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded (Rn) (management subgroup 1B).—This mapping unit occurs in numerous small areas around drainageways. Seventy-five percent or more of the original surface soil has been removed by erosion, and frequently some of the subsoil. The present surface soil is thin, usually less than 3 inches

thick. It is a yellowish-brown heavy silt loam to silty clay loam—plastic and sticky when wet and very hard when dry. The surface soil makes a very poor seedbed. It absorbs water more slowly than the original surface soil, and the organic-matter content and fertility are very low. In other respects this mapping unit is similar to Russell silt loam, 3 to 8 percent slopes.

Use and management.—As yields decline on these soils, many farmers shift from corn to soybeans and use unproductive areas for permanent pasture. Small areas in fields with other soils are farmed much like those soils. Erosion can be controlled and productivity built up by contour tilling, adequate liming, liberal fertilizing, and adopting a 5-year crop rotation consisting of corn, wheat, and an alfalfa-bromegrass mixture for 3 years. Larger, less productive areas can be used more economically as woods or permanent bluegrass pasture.

Russell silt loam, 0 to 3 percent slopes (Re) (management subgroup 1A).—This soil is associated with the other Russell soils and the Fincastle soil. It is similar to Russell silt loam, 3 to 8 percent slopes. Surface drainage is slow, but internal drainage is well established, probably because permeable beds of fine gravel and sand are within 10 feet of the surface. Where this soil grades to Fincastle soil, the subsoil below a depth of 16 inches is mottled gray and yellowish brown.

Use and management.—This is the most intensively used phase of Russell silt loam. Since erosion is not a problem, yields can be improved by increasing the organic-matter content and by improving the structure and moisture-holding capacity. Suggested for a grain system of farming is a 3-year crop rotation of corn, soybeans, and wheat with a sweetclover intercrop. In a grain-livestock system either of the following is suggested: A 3-year rotation consisting of corn, wheat, and meadow or a 5-year rotation of corn, corn or soybeans, wheat, and meadow for 2 years.

Russell silt loam, 8 to 12 percent slopes (Rh) (management subgroup 1C).—This soil has a profile similar to that of Russell silt loam, 0 to 3 percent slopes, but the horizons are thinner and the underlying calcareous till often occurs nearer the surface. It occurs as long narrow areas along upper courses of streams that are cutting into the till plain. Surface runoff is rapid, and erosion is severe under cultivation. Local variation in surface texture is more common than on less sloping phases. Some areas, principally those near the county line north of Lockport, may contain enough sand to be classified as a loam.

Use and management.—Farmers have kept a large part of this soil in woods or wooded pasture. About half of the cleared land is used for permanent pasture, and the rest for crops. Corn, wheat, and mixed hay are the principal crops. Yields are somewhat lower than on Russell silt loam, 0 to 3 percent slopes, because runoff carries away soil material and reduces fertility. Winter wheat and hay are better suited to this soil than corn and oats because they provide a more complete plant cover through the year.

Russell silt loam, 8 to 12 percent slopes, eroded (Rk) (management subgroup 1C).—This phase occurs on short slopes or breaks around the heads of drainageways and frequently includes small areas of steeper soil. It is similar to Russell silt loam, 3 to 8 percent slopes, eroded, but has lost more surface soil under cultivation.

Use and management.—Although the prevailing slope, about 11 percent, is greater, and runoff more rapid than on Russell silt loam, 3 to 8 percent slopes, damage to this soil has been caused mainly by intensive cultivation. About 85 percent of the land in this phase is used for crops or pasture. It is much more intensively cultivated than Russell silt loam, 3 to 8 percent slopes. Yields are low under the prevailing management. Much of the pasture is weedy, has a poor stand of grass, and has a relatively low carrying capacity.

Russell silt loam and silty clay loam, 8 to 12 percent slopes, severely eroded (Ro) (management subgroup 1D).—The soils of this unit differ from Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded, only in degree of slope. On a large proportion of the area the yellowish-brown subsoil is exposed. Occasionally erosion has removed all the soil down to the calcareous parent material and left many glacial pebbles and small stones at the surface. Shallow gullies, 1 to 3 feet in depth, are present, and in a few places are quite numerous.

Use and management.—Severe erosion bordering on destruction of the soil has been caused by use of land not suited to grains and rotation farming. More than 90 percent of this mapping unit is used for crops and pasture, but crop yields are too low for profitable farming. The best use is permanent pasture and forestry, but some less severely eroded areas might be used for longtime meadows. Gullied and very severely sheet-eroded areas should be reforested. Permanent bluegrass pasture of good quality and carrying capacity can be obtained by liming, fertilizing, and reseeding. Sweetclover grows readily where the limy parent material is exposed.

Russell silt loam, 12 to 25 percent slopes (Rl) (management subgroup 1D).—This soil occupies the upper slopes of deeper valleys, where it is associated with Hennepin loam, 25 to 65 percent slopes. Runoff is very rapid, and erosion is potentially severe under cultivation. The soil is similar to Russell silt loam, 3 to 8 percent slopes, but the horizons are usually thinner and the parent material occurs at shallower depths. In many places the soil is somewhat gritty and pebbly from the surface downward, and calcareous glacial till is present within a depth of 36 inches. In these areas the soil is similar to Miami soils. On the steeper slopes, where this soil grades to the Hennepin soil, the surface layer is slightly darker in color, is nearly neutral in reaction, and contains considerable amounts of sand.

Use and management.—A small proportion of this phase is used for grains and hay, and about 80 percent of it is used as permanent pasture or woodland. When the soil is cropped, yields decline rapidly because soil is lost through erosion and organic matter and fertility are depleted. Permanent pastures are easily overgrazed during midsummer.

Russell silt loam, 12 to 25 percent slopes, eroded (Rm) (management subgroup 1D).—This phase is similar to Russell silt loam, 3 to 8 percent slopes, eroded, except for degree of slope. About 33 percent of it has never been cleared of timber, but some of the woodland pastures have been seriously eroded as a result of overgrazing.

Use and management.—Grains and hay crops are grown to some extent, but yields are low and decline rapidly under continuous cropping. The soil is best suited to forest and permanent pasture. Thin stands of grass require renovation and the addition of legumes.

Russell silt loam and silty clay loam, 12 to 25 percent slopes, severely eroded (Rp) (management subgroup 1D).—Except for degree of slope, this mapping unit is similar to Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded. These soils take in only a small amount of moisture; consequently, runoff is high and erosion is severe.

Use and management.—About 85 percent of this unit has been cropped or pastured in the past. Rotation crops were grown on much of it in 1940, but yields were low. It is now a common practice to grow soybeans instead of corn, probably because they are more drought resistant. Soybeans also improve the physical condition of the clayey plow soil. Gullied and more unproductive areas should be returned to forest, and the rest used for pasture. Permanent pastures require liming, fertilizing, and seeding with a suitable mixture of grass and legumes.

Sleeth Series

Sleeth silt loam, 0 to 3 percent slopes (Sa) (management group 5).—This soil occurs on higher and older alluvial terraces and outwash plains. It developed from silty and loamy outwash, 42 to 70 inches thick, that overlies calcareous sand and gravel of Wisconsin age. It is similar to the Homer soil in natural drainage but is more acid and more deeply leached. This soil is the imperfectly drained member of the catena that includes the well-drained Ockley and the very poorly drained Westland and Abington soils. It occupies level to slightly depressed positions between Ockley and Westland soils. Its slope seldom exceeds 1 percent.

Under natural conditions the water table is near the surface much of the time, but most of this soil is now artificially drained for cropping. A heavy forest of water-tolerant trees, chiefly beech, maple, sycamore, ash, elm, and swamp white oak, originally covered the soil.

Profile in cultivated area:

0 to 8 inches, grayish-brown to light grayish-brown smooth silt loam; organic-matter content relatively low; weak medium granular structure; friable when moist; medium to slightly acid.
8 to 11 inches, gray to light grayish-brown silt loam; weak platy to moderate coarse granular structure; friable; medium acid.
11 to 17 inches, mottled gray and yellowish-brown light silty clay loam; moderate fine subangular blocky structure; slightly firm; medium to strongly acid.
17 to 30 inches, mottled gray, yellowish-brown, and brownish-yellow silty clay loam; moderate medium subangular blocky structure; firm when moist, plastic when wet, and hard when dry; medium to strongly acid.
30 to 60 inches, mottled yellowish-brown and gray sandy clay loam, clay loam, or heavy loam; clay content usually increases with depth; weak coarse subangular blocky structure; firm; medium acid in upper part, grading to slightly acid or neutral in lower 2 or 3 inches; lower few inches often darker colored than the rest of layer.
60 inches +, pale-brown or light brownish-gray stratified gravel and sand; calcareous.

The depth to mottling varies from about 7 to 16 inches. The depth to gravel and sand ranges from 42 to 72 inches. The stratified gravel and sand is underlain by loam till at depths of 7 to 10 feet in some areas. In some areas, unassorted till occurs at relatively shallow depths.

Use and management.—Use and crop yields are similar to those on Homer soil. A 4-year crop rotation of corn, soybeans, wheat, and meadow is commonly followed. The water table can be lowered by open drainage ditches. Tile drainage is satisfactory if the lines can be laid in moderately clayey soils. If laid in sand, they fill or get out of line.

If it is adequately drained, limed, and fertilized, the soil is well suited to all crops commonly grown. Because of leaching and acidity, lime is required to grow clovers and alfalfa successfully.

Sloan Series

This series consists of dark-colored soils in depressions that are subject to occasional stream overflow. The soils occupy swales and depressions on the terraces or in the bottoms along the larger streams. Natural drainage is very slow. Swamp timber such as sycamore, cottonwood, and willow originally covered these areas.

Sloan silty clay loam, 0 to 3 percent slopes (Sc) (management subgroup 6C).—This soil occurs in the deeper depressions where ponded drainage prevails. The alluvial sediments are of medium to heavy texture.

Profile in cultivated areas:

0 to 9 inches, dark-brown to very dark gray silty clay loam; organic-matter content variable but usually relatively high; thin lenses of brown heavy silt loam may occur throughout this layer; weak medium granular structure; friable to firm when moist; neutral.
9 to 20 inches, very dark brown to black silty clay loam; weak coarse granular to weak medium blocky structure; firm.
20 to 45 inches, gray, grading to mottled gray and yellowish-brown, silty clay loam or clay loam; texture and color are variable; content of sand and gravel is variable but usually increases with depth; neutral.
45 inches +, mottled gray and brownish-yellow stratified silt, clay, sand, and gravel; neutral to calcareous.

In the lower lying areas, drainage is poorer, the organic-matter content is usually higher, and the dark color extends to a greater depth. The subsoil is frequently gray. In several areas the soil occurs on rock terraces and is underlain by limestone or shale at depths of 3 to 5 feet.

Use and management.—This highly fertile soil is largely under cultivation. Corn, soybeans, meadow,

and pasture are the principal crops. Small grains are likely to be drowned out in the fall, or their seeding may be delayed in the spring. Corn, the principal crop, is grown several years in succession. Drainage is the principal problem as suitable outlets are often limited. Weed control, a problem in continuous corn culture, may be achieved by occasionally growing soybeans, small grains, or grass. Potassium deficiency may limit yields of corn on the wetter areas. Because of inadequate drainage, sweetclover is a more suitable legume than either red clover or alfalfa.

Sloan silt loam, 0 to 3 percent slopes (Sb) (management subgroup 6C).—This soil occurs in positions similar to those occupied by Sloan silty clay loam, 0 to 3 percent slopes, but it is overflowed more often and receives a greater amount of stream-deposited material.

The surface soil is usually silt loam, but there are a few spots of sandy or loamy material. The surface soil is slightly lighter colored and lower in organic-matter content than the Sloan silty clay loam. Though this soil is level, surface drainage is more favorable for rotation crops than on the Sloan silty clay loam.

Use and management.—Corn is the principal crop, but soybeans and oats frequently are grown. Meadow and permanent pasture are important on this phase. A suitable 4-year crop rotation is corn, soybeans, and oats, followed by a sweetclover intercrop or by mixed meadow. Management problems and crop yields are similar to those on Sloan silty clay loam.

Washtenaw Series

Washtenaw silt loam, 0 to 3 percent slopes (Wa) (management subgroup 6A).—This soil occupies shallow to deep kettle holes and depressions. The small areas are widely scattered, most of them on the upland. The light-colored soil has formed from material washed from Russell, Miami, Ockley, or other soils of the uplands and terraces. The material accumulated on the dark-colored Brookston, Kokomo, and Westland soils.

Natural drainage ranges from imperfect to poor. Even if the soil is artificially drained, water stands on many of these areas from a few hours to a few days after heavy rains. One of the major problems is getting outlets for artificial drainage. Most of the original forest cover of water-loving trees has now been cleared.

Profile in cultivated areas:

0 to 8 inches, grayish-brown or brown silt loam; organic-matter content variable but usually moderate to low; weak medium granular structure; friable when moist; slightly acid to neutral.
8 to 20 inches, grayish-brown to dark grayish-brown light silt loam to heavy silt loam; weak platy to very weak coarse granular structure; friable to firm; slightly acid to neutral.
20 to 33 inches, very dark grayish-brown silty clay loam or clay loam; organic-matter content is high; weak coarse blocky structure; firm; neutral to slightly acid.
33 to 50 inches +, mottled gray and yellowish-brown heavy silty clay loam to heavy clay loam; weak very coarse blocky structure; very firm; neutral; grades to calcareous till.

In the prairie areas such as the Longlois soil, west and northwest of Pittsburg, the colluvial wash is dark brown and the soils are moderately well drained. In the upper layers the lighter-colored material ranges from about 10 to 40 inches in thickness. The surface soil is a loam in some areas.

Use and management.—General farming is practiced. Use of the small areas, especially those with fair drainage, is largely determined by use of the associated soils. Elsewhere corn is the principal crop, but soybeans, oats, meadow, and pasture are important where less favorable drainage makes growing of corn more hazardous. Fall-seeded small grains and red clover, alfalfa, or similar legumes are likely to be injured by standing water or by winterkilling.

Westland Series

Westland soils occur in elongated swales and depressions. On the high terraces are the associated Ockley and Sleeth soils and on lower terraces are the Fox and Homer soils. The slope rarely exceeds 1 percent. The underlying material consists of calcareous, assorted, and stratified gravel and sand. Sand is dominant where these soils are associated with the Ockley soils. Natural drainage was poor on these soils. The swamp forests consisted largely of elm, ash, soft maple, and birch. Most areas are now cleared and sufficiently drained to grow crops. Drainage is done mainly by open ditches.

Westland silty clay loam, 0 to 3 percent slopes (Wd) (management subgroup 6B).—This soil type occurs along former glacial drainageways throughout the county.

Profile in cultivated areas:

0 to 8 inches, very dark grayish-brown silty clay loam; moderate medium granular structure; firm when moist; slightly acid to neutral.
8 to 16 inches, very dark grayish-brown to black silty clay loam; weakly mottled with yellowish brown in lower part of horizon; weak coarse granular to weak fine subangular blocky structure; firm; slightly acid to neutral.
16 to 24 inches, mottled gray, brownish-yellow, and yellowish-brown heavy silty clay loam or heavy clay loam; moderate coarse blocky structure; very firm; slightly acid to neutral.
24 to 45 inches, mottled gray and yellowish-brown clay loam, silty clay loam, or gravelly clay loam; gravel content usually increases with depth; weak coarse blocky structure; very firm; neutral.
45 inches +, pale-brown or gray, mottled with brownish-yellow, stratified, loose sand and gravel; calcareous.

The surface and subsurface layers are darker colored, thicker, and higher in organic matter where associated with Longlois soil than where associated with Ockley and Fox soils. Depth to gravel and sand ranges from 40 to 60 inches or more and is usually greater in those areas associated with Ockley soils. Some areas in the northwestern part of the county are underlain by loam till at depths of from 7 to 10 feet.

Use and management.—About 90 percent of this soil type is used for rotation crops. A 4-year rotation of corn, soybeans, a small grain, and meadow is extensively followed. Since this soil occurs in large areas of uniform slope, corn is often grown 2 years or more

in succession. Inadquate drainage is the principal limitation on crop production. In adequately drained areas, all crops produce high yields. Wheat, red clover, and alfalfa are the crops most frequently injured by standing water. Mixed seedings are used for meadows to insure a stand if the legumes drown. Potassium deficiency may limit corn yields in wet areas. Excessive growing of corn or other row crops may result in poor structure and physical condition, as the organic matter is depleted.

Westland silt loam, 0 to 3 percent slopes (Wc) (management subgroup 6B).—This soil is similar to Westland silty clay loam, 0 to 3 percent slopes, but differs principally in having a silt loam surface soil and clay loam lower subsoil. In many places the silty surface soil results from deposits washed from adjacent soils of the higher terraces or upland. In areas where these deposits were left, the soil may be slightly lower in organic matter than elsewhere and slightly acid in reaction.

Use and management.—Crop yields on this soil are similar to those on Westland silty clay loam, 0 to 3 percent slopes. Since this soil occurs in small areas associated with Ockley and Homer soils, its use is largely determined by the use of those soils.

Westland loam, 0 to 3 percent slopes (Wb) (management subgroup 6B).—This soil occurs in narrow swales that are difficult to drain because of seepage from adjoining uplands. The profile is similar to that for Westland silty clay loam, 0 to 3 percent slopes. It differs principally in having a loam surface soil, a light clay loam upper subsoil, and a sandy or gravelly clay loam lower subsoil.

Use and management.—This soil usually contains less organic matter, and yields are more readily reduced by intensive farming. Although the soil is well suited to corn, a crop rotation that includes a legume is essential to maintain productivity. This soil is more likely to be deficient in potassium than Westland silty clay loam, 0 to 3 percent slopes, because it contains more sand and less clay.

Land Capability Classification

The soils of Carroll County have been grouped to show their suitability for crops, grazing, forestry, and wildlife. This grouping is based on the uses that can be made of each soil, its needs for management, and the hazards of soil erosion or other damage when it is used. Since it is a practical grouping based on needs and responses, it can bring together, in one group, soils that were formed from different parent materials or in different ways.

There are eight general land capability classes, but all do not necessarily occur in a particular area. Class I land is nearly level and has few limitations; the soils are productive and not subject to erosion. Class VIII land has little or no useful vegetation because the soils are too rough or stony, or too wet, or too droughty, or are limited in some other way.

Classes I, II, and III are suitable for some of the crops ordinarily grown in the locality that require annual, or at least periodic, tillage. Management needs, or risks of damage, or both, are successively greater on soils in class II and class III than on those in class I. Soils in class IV are less suitable for a regular cropping system than those in the first three classes, but they can be used for tillage part of the time or with special precautions. In addition, soils in all four of these classes ordinarily are well suited for uses that require little or no cultivation, such as grazing, forestry, or wildlife. Management needs and probable yields can vary a great deal on the different soils.

Soils not suitable for cultivation, or that require extreme management of any kind, including those soils subject to severe erosion if cultivated, are placed in classes V, VI, VII, or VIII. Class V contains soils that are nearly level and not subject to erosion, but they are too wet, too frequently overflowed, or too stony for cultivation. Soils placed in class VI are more limited in one or more features than those in class IV, but they will supply some forage, orchard crops, or forest products. Some soils in class VI can be cultivated enough to prepare them for longtime forage, orchards, planted forests, or special perennial crops.

Soils in class VII are more limited than those in class VI. Generally they must be managed by harvesting the native cover or a partly controlled succession of plants. The choices in management are fewer, production is less, or risk of erosion is greater than on the soils in class VI.

Class VIII consists of soils so severely limited that they produce little useful vegetation. They may provide scenery or furnish shelter for wildlife. Some make up parts of watersheds in which runoff should be controlled.

Subclasses.—Each of the eight classes contains soils that have limitations and management problems of about the same degree. The soils within a class may be of different kinds, however, and therefore the kinds of limitations are different. The dominant kind of limitation is indicated by one of four subclasses. The four subclasses indicate: Soil subject to erosion if cover is not maintained, designated by the symbol (e); excess water either on or in the soil (w); shallow, droughty, or infertile soil (s); or soil limited chiefly by climate (c). Usually not all the subclasses will occur in an area the size of a county.

The capability classes and subclasses in Carroll County are given in the following list. Only the general nature of the principal soils in each subclass is described.

Class I.—Deep, well-drained, nearly level, productive soils. Suitable for longtime intensive cultivation if good farming practices are followed.

Class II.—Soils that can be cultivated with only moderate risk of erosion or soils that have only slight limitation in use.

IIe: Gently sloping silty and loamy soils.

IIw: Nearly level soils with moderate limitations caused by excess water.

IIs: Nearly level and gently sloping soils with only moderate capacity for holding moisture for plants.

Class III.—Soils that are suited to cultivation in a regular cropping system, but require special treatment or protection to maintain productivity; moderately severe risks of erosion or other moderately severe limitations.

IIIe: Gently sloping or sloping soils that are subject to erosion.

IIIw: Very poorly drained organic soils.

IIIs: Gently sloping and sloping somewhat droughty soils.

Class IV.—Soils that are severely limited in use or subject to high risk of damage if used for tilled crops; suited to cultivation if specially managed.

IVe: Moderately steep to steep soils, most of them eroded.

IVs: Sloping to steeply sloping eroded soils with low capacity for holding moisture for plants.

Class V.—Soils suited to pasture but not suited to cultivation because of excess water.

Vw: Bottom-land soils subject to frequent overflow and very poorly drained organic soils.

Class VI.—Soils not suitable for regular cultivation because they are too steep, or too droughty; suited to the occasional shallow tillage needed to establish forage or trees.

VIe: Moderately steep, steep, and very steep soils.

VIs: Moderately steep and steep, eroded, droughty soils.

Class VII.—Soils not suited to cultivation and having serious hazards or limitations when used for forage or as woodland.

VIIe: Very steep soils.

VIIs: Very droughty soils.

Class VIII.—Land types suited to wildlife or recreation but not to commercial production of crops. Gravel pits are included in this class. Subclasses are not used in class VIII.

The soils of Carroll County are listed by capability class and subclass as follows:

	Capability class and subclass
Abington silty clay loam, 0 to 3 percent slopes (Aa)	IIw.
Brookston silty clay loam, 0 to 3 percent slopes (Bc)	IIw.
Carlisle muck (Ca)[1]	IIIw, Vw.
Cope silt loam, 0 to 3 percent slopes (Cb)	IIw.
Cope silty clay loam, 0 to 3 percent slopes (Cc)	IIw.
Crosby silt loam, 0 to 3 percent slopes (Cd)	IIw.
Edwards muck (Ea)[1]	IIIw, Vw.
Eel loam, 0 to 3 percent slopes (Eb)	IIw.
Eel silt loam, 0 to 3 percent slopes (Ec)	IIw.
Eel silty clay loam, 0 to 3 percent slopes (Ed)	IIw.
Farmington silt loam, 0 to 4 percent slopes (Fa)	IIIs.
Fincastle silt loam, 0 to 3 percent slopes (Fb)	IIw.
Fox loam and clay loam, 8 to 12 percent slopes, severely eroded (Fc)	IVs.
Fox loam and clay loam, 12 to 25 percent slopes, severely eroded (Fd)[2]	VIs, VIIs.
Fox fine sandy loam, 0 to 3 percent slopes (Fe)	IIIs.
Fox loam, 0 to 3 percent slopes (Ff)	IIs.
Fox loam, 3 to 8 percent slopes, eroded (Fg)[2]	IIs, IIIs.
Fox loam, 8 to 12 percent slopes (Fh)	IIIs.
Fox loam, 8 to 12 percent slopes, eroded (Fk)	IIIs.
Fox loam, 12 to 25 percent slopes (Fl)	IVs, VIs.
Fox loam, 12 to 25 percent slopes, eroded (Fm)[2]	IVs, VIs.
Fox silt loam, 0 to 3 percent slopes (Fn)[2]	I, IIs.
Fox silt loam, 3 to 8 percent slopes (Fo)[2]	IIs, IIIs.
Fox loam, 3 to 8 percent slopes (Fp)[2]	IIs, IIIs.
Fox loam, 3 to 8 percent slopes, eroded kame phase (Ba)[2]	IIs, IIIs.
Fox loam, 8 to 25 percent slopes, eroded kame phase (Bb)[2]	IIs, IVs, VIs.
Genesee fine sandy loam, 0 to 3 percent slopes (Ga)[2]	I, IIs.
Genesee fine sandy loam, high bottom, 0 to 3 percent slopes (Gb)[2]	I, IIs.
Genesee loam, 0 to 3 percent slopes (Gc)[1]	I, V.
Genesee loam, high bottom, 0 to 3 percent slopes (Gd)	I.
Genesee silt loam, 0 to 3 percent slopes (Ge)[1]	I, V.
Genesee silt loam, high bottom, 0 to 3 percent slopes (Gf)	I.
Gravel pits[3]	VIIs, VIII.
Hennepin loam, 25 to 65 percent slopes (Ha)[2]	VIe, VIIe.
Homer silt loam, 0 to 3 percent slopes (Hb)	IIw.
Kokomo silty clay loam, 0 to 3 percent slopes (Ka)	IIw.
Longlois silt loam, 0 to 3 percent slopes (La)	I.
Lyles loam, 0 to 3 percent slopes (Lb)	IIw.
Metea fine sandy loam, 3 to 8 percent slopes (Ma)[2]	IIs, IIIs.
Miami silt loam, 3 to 8 percent slopes (Mb)[2]	IIe, IIIe.
Miami silt loam, 3 to 8 percent slopes, eroded (Mc)[2]	IIe, IIIe.
Miami silt loam, 8 to 12 percent slopes, eroded (Md)	IIIe.
Miami silt loam, 12 to 18 percent slopes, eroded (Me)	IVe.
Millsdale silty clay loam, 0 to 3 percent slopes (Mf)	IIw.
Milton silt loam, 0 to 5 percent slopes (Mg)	IIs.
Monitor silt loam, 0 to 3 percent slopes (Mh)	IIw.
Nineveh loam, 0 to 3 percent slopes (Na)	IIIs.
Oaktown loamy fine sand, 3 to 10 percent slopes (Oa)[2]	IIIs, IVs, VIIs.
Ockley loam, 0 to 3 percent slopes (Ob)[2]	I, IIe.
Ockley loam, 3 to 8 percent slopes (Oc)[2]	IIe, IIIe.
Ockley loam, 3 to 8 percent slopes, eroded (Od)[2]	IIe, IIIe.
Ockley silt loam, 0 to 3 percent slopes (Oe)[2]	I, IIe.
Ockley silt loam, 3 to 8 percent slopes (Of)[2]	IIe, IIIe.
Ockley silt loam, 3 to 8 percent slopes, eroded (Og)[2]	IIe, IIIe.
Rodman gravelly loam, 25 to 60 percent slopes (Ra)	VIIe.
Ross loam, 0 to 3 percent slopes (Rb)	I.
Ross silt loam, 0 to 3 percent slopes (Rc)	I.
Ross silty clay loam, 0 to 3 percent slopes (Rd)	I.
Russell silt loam, 0 to 3 percent slopes (Re)[2]	I, IIe.
Russell silt loam, 3 to 8 percent slopes (Rf)[2]	IIe, IIIe.
Russell silt loam, 3 to 8 percent slopes, eroded (Rg)[2]	IIe, IIIe.
Russell silt loam, 8 to 12 percent slopes (Rh)	IIIe.
Russell silt loam, 8 to 12 percent slopes, eroded (Rk)	IIIe.
Russell silt loam, 12 to 25 percent slopes (Rl)[2]	IVe, VIe.
Russell silt loam, 12 to 25 percent slopes, eroded (Rm)[2]	IVe, VIe.
Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded (Rn)[2]	IIIe, IVe.
Russell silt loam and silty clay loam, 8 to 12 percent slopes, severely eroded (Ro)[2]	IVe, VIe.
Russell silt loam and silty clay loam, 12 to 25 percent slopes, severely eroded (Rp)	VIe, VIIe.
Sleeth silt loam, 0 to 3 percent slopes (Sa)	IIw.
Sloan silt loam, 0 to 3 percent slopes (Sb)	IIw.

	Capability class and subclass
Sloan silty clay loam, 0 to 3 percent slopes (Sc)	IIw.
Washtenaw silt loam, 0 to 3 percent slopes (Wa)	IIw.
Westland loam, 0 to 3 percent slopes (Wb)	IIw.
Westland silt loam, 0 to 3 percent slopes (Wc)	IIw.
Westland silty clay loam, 0 to 3 percent slopes (Wd)	IIw.
Linwood muck (We)[1]	IIIw, Vw.

[1] These mapping units include more than one capability class because the concept of mapping has changed from the time the fieldwork was completed to present day concepts of land capability classification.

[2] These mapping units include more than one capability class because of changes in classification concepts and in the ranges of slope groups from the time the fieldwork was completed to present day concepts of land capability classification.

[3] This mapping unit includes more than one capability class because of minor inclusions.

Morphology and Genesis of Soils

Factors of Soil Formation

Soil is a natural three-dimensional body on the landscape. It is the product of weathering and biological forces acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given time are determined by interrelationships of—

1. The physical and mineralogical composition of the parent material.
2. The climate under which the soil material accumulated and the soil-forming processes acted.
3. The plant and animal life on and in the soil.
4. The relief or lay of the land.
5. The length of time the forces of soil development have acted on the soil material.

Both climate and vegetation are active factors of soil genesis. They act on the parent material accumulated through the weathering of rocks and slowly change it into distinct layers (genetically related horizons) that make up the soil profile. The nature of the parent material also affects the kind of profile that can be formed and, in extreme cases, dominates it entirely. Finally, time is needed to change the parent material into a soil profile. Usually a long time is required for the development of distinct horizons.

Carroll County lies in the region of Gray-Brown Podzolic soils that occupies the east-central part of the United States (*1*). It borders the Brunizem (Prairie) soil region that lies to the west. Most of the soils have developed under a heavy forest cover of deciduous trees, and there has been rainfall enough to wet the soil to an indefinite depth; therefore, except during short periods, a moist condition is maintained throughout the soil. The climatic and biological conditions permit only a relatively thin surface accumulation of organic litter and a few inches of dark-colored soil in the upper part of the profile. The surface mat of organic matter is thinner than in the Podzol region to the north, but thicker than in the Red-Yellow Podzolic region to the south.

The soils of Carroll County have formed mainly from outwash and till of the Wisconsin glaciation. The outwash is assorted material, largely gravel and sand. The till is unassorted, medium textured, and highly calcareous. Its thickness varies, but in most areas the deposit is of such depth that carbonates have been only partly leached from the soil profile. The depth to carbonates ranges from 24 to about 42 inches.

Some of the soils have been influenced by a mantle of windblown silt, or loess. This mantle, 18 to 36 inches deep, and deeper in level areas, was deposited during and after the Wisconsin glaciation. The soils with this silt mantle generally are south of those that have no mantle or a very thin one. In the areas that have 18 inches or more of loess, the carbonates are at depths of 42 to 70 inches. The greater depth to carbonates is largely accounted for by the silt mantle. Wind-deposited sands occupy the east sides of valleys along the larger streams.

Classification of Soils

The soils of Carroll County belong to these great soil groups: Gray-Brown Podzolic; Gray-Brown Podzolic intergrading to Brunizems; Humic Gley; Brown Forest; Rendzina; Alluvial; and Organic.

Table 10 classifies the soil series of Carroll County by great soil groups and shows drainage, relief, and parent material for each series. Soil series listed in one horizontal line have developed from similar parent material; differences in their profile are largely dependent on differences in natural drainage that prevailed during their development. Such a grouping of soil series developed from similar material is called a catena. The soils listed vertically under a given roman numeral[5], or major profile number, have similar natural drainage, but they differ in profile characteristics because they developed from different kinds of parent materials.

Gray-Brown Podzolic soils

The Gray-Brown Podzolic soils have a thin dark-colored A_1 horizon, a light-colored eluviated A_2 horizon, and an illuviated B horizon that is usually finer textured than the A, C, or D horizon. The accumulation of clay in the B horizon probably represents both downward movement from the A horizon and development of clay in place. The soil series in the Gray-Brown Podzolic group are well drained, well drained to excessively drained, and imperfectly drained. (See table 10).

WELL-DRAINED GRAY-BROWN PODZOLIC SOILS.—The members of this group are soils of the Russell, Miami, Metea, and Milton series.

Russell soils are representative of the well-drained Gray-Brown Podzolic soils. They have developed on 18 to 36 inches of loess that overlies weathered loam or light clay loam till of Wisconsin age. The till is calcareous at depths ranging from 42 to about 70 inches. Table 11 gives analytical data for a profile of Russell silt loam.

[5] Roman numerals are those used in the Indiana system of profile designation (*2*).

TABLE 10.—*Soil series of Carroll County, Ind., classified by great*

Great soil groups	Gray-Brown Podzolic soils			Gray-Brown Podzolic soils intergrading to Brunizem	
Major profile (Indiana system) [2]	V	IV	II	V	II
Drainage [3]	Good to excessive	Good	Imperfect	Good to somewhat excessive	Imperfect
Relief	Nearly level to strongly sloping	Nearly level to strongly sloping	Nearly level to gently sloping	Nearly level to sloping	Nearly level
Parent or underlying material—					
Highly calcareous loam to light clay loam glacial till of Wisconsin age, leached 24 to 42 inches.	----------	Miami-------	Crosby------	----------	----------
Loess 18 to 36 inches thick over highly calcareous loam to light clay loam glacial till of Wisconsin age, leached 42 to 70 inches.	----------	Russell------	Fincastle----	----------	----------
Medium to moderately fine textured glacial drift of Wisconsin age, 20 to 42 inches thick, over bedrock.	----------	Milton------	----------	----------	----------
Sandy outwash, 20 to 40 inches thick, over loam till, calcareous at depths of 40 to 54 inches.	----------	Metea-------	----------	----------	----------
Medium-textured drift, 6 to 24 inches thick, over limestone bedrock.	----------	----------	----------	----------	----------
Silty and loamy outwash, 24 to 42 inches thick, over stratified calcareous gravel and sand.	Fox---------	----------	Homer------	----------	----------
Silty and loamy outwash, 42 to 70 inches thick, over stratified calcareous gravel and sand.	Ockley------	----------	Sleeth-------	----------	----------
	----------	----------	----------	Longlois-----	Monitor-----
Loamy drift, 5 to 10 inches thick, over stratified calcareous gravel and sand.	----------	----------	----------	----------	----------
Loamy sand to sand; mildly alkaline to slightly acid.	Oaktown-----	----------	----------	----------	----------
Medium to moderately fine textured alluvium from Wisconsin drift; neutral to alkaline.	----------	----------	----------	----------	----------
Medium-textured slightly acid to neutral alluvium, 10 to 40 inches thick, over dark-colored moderately fine textured material.	----------	----------	----------	----------	----------
Black woody muck over peaty material; medium acid to neutral; more than 42 inches thick.	----------	----------	----------	----------	----------
Black muck, 12 to 42 inches thick, over gray marl.	----------	----------	----------	----------	----------
Black muck, 12 to 42 inches thick, over medium-textured mineral material.	----------	----------	----------	----------	----------

[1] Soils that would key into many of the blank spaces have been mapped elsewhere in the State.
[2] With some modifications, based on The Story of Indiana Soils, by T. M. Bushnell, Purdue University Agricultral Experiment Station, Special Circular 1, 52 pp.
[3] "Good" is equivalent to "well;" that is, a soil with "good" drainage is "well drained."

soil group, and drainage, relief, and parent material for each series [1]

Humic Gley soils			Brown Forest soils	Rendzina soils	Alluvial soils			Organic soils
VII	VIII	IX	V	VI	IV	III	VII	X
Poor	Very poor	Very poor	Good to somewhat excessive	Excessive	Good	Moderately good	Poor to very poor	Very poor to ponded
Nearly level to slightly depressional	Nearly level to depressional	Nearly level to depressional	Nearly level	Steep	Nearly level	Nearly level	Nearly level to depressional	Nearly level to depressional
Cope	Brookston	Kokomo		Hennepin				
Cope	Brookston	Kokomo						
	Millsdale [4]	Millsdale [4]						
			Farmington					
			Nineveh					
	Westland	Abington						
	Westland	Abington						
				Rodman				
	Lyles							
					Genesee, Ross [5]	Eel	Sloan [6]	
							Washtenaw [7]	
								Carlisle.
								Edwards.
								Linwood.

[4] Millsdale soil is mapped in both drainage positions.
[5] Ross soils have darker colored surface soils than Genesee soils.
[6] Sloan soils are not true Alluvial soils; they are intergrades to Humic Gley soils.
[7] Drainage of Washtenaw soil ranges from imperfect to very poor.

TABLE 11.—*Analytical data for Russell silt loam (T. 25 N., R. 1 W., sec. 17)*

MECHANICAL ANALYSES

Sample No.	Horizon	Depth	Size class and diameter of particles (in mm.)							Other classes (in mm.)	
			Very coarse sand, 2.0–1.0	Coarse sand, 1.0–0.5	Medium sand, 0.5–0.25	Fine sand, 0.25–0.1	Very fine sand, 0.1–0.05	Silt, 0.05–0.002	Clay, <0.002	0.02–0.002	>2.0
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
286101	A_1	0– 6	1.0	2.4	4.6	9.4	7.5	60.4	14.7	33.2	2
286102	A_2	6– 9	1.5	2.4	4.5	9.5	7.4	60.1	14.6	32.1	2
286103	B_1	9–14	.6	1.3	2.1	4.6	4.9	61.3	25.2	37.9	1
286104	B_{21}	14–30	.3	.7	1.1	2.4	3.7	64.6	27.2	41.3	.5
286105	B_{22}	30–51	1.9	5.1	8.7	20.4	12.4	32.3	19.2	17.0	9
286106	C	51+	3.0	5.5	8.4	19.2	13.5	36.1	14.3	16.9	7

CHEMICAL ANALYSES

Sample No.	Horizon	Depth	pH	Exchangeable cations (m.e./100 gm.)						Base saturation	Organic carbon
				Ca	Mg	K	Na	H	Sum		
		Inches								*Percent*	*Percent*
286101	A_1	0– 6	5.8	5.9	1.7	0.2	0.2	4.9	12.9	62	0.87
286102	A_2	6– 9	5.7	5.8	1.7	.2	.2	4.7	12.6	63	.86
286103	B_1	9–14	5.4	7.7	1.9	.3	.3	6.7	16.9	60	.40
286104	B_{21}	14–30	5.0	7.5	2.4	.3	.2	8.5	18.9	55	.32
286105	B_{22}	30–51	5.6	5.9	2.4	.2	.3	4.3	13.1	67	.24
286106	C	[1] 51+									

[1] Calcareous.

Representative profile of Russell silt loam in a wooded area:

A_0 ¼ to 0 inch, very dark brown partially decomposed leaves, twigs and stems; pH 7.2.[6]

A_1 0 to 2 inches, very dark grayish-brown (10YR 3/2, moist)[7] silt loam; high organic-matter content; weak fine granular structure; friable when moist and soft when dry; pH 6.9.

A_2 2 to 11 inches, grayish-brown to dark grayish-brown (10YR 5/2 to 4/2, moist) silt loam; weak thin platy structure; friable; small roots numerous; pH 6.6.

B_1 11 to 18 inches, brown (7.5YR 5/4, moist) light silty clay loam; moderate fine subangular blocky structure; slightly firm; pH 5.6.

B_{21} 18 to 33 inches, brown to dark-brown (7.5YR 4/4, moist) silty clay loam; moderately coarse subangular blocky structure; firm; pH 5.7.

B_{22} 33 to 46 inches, dark yellowish-brown or yellowish-brown (10YR 4/4 to 5/4, moist) clay loam to silty clay loam; moderate coarse subangular blocky structure; firm; content of sand and partially weathered rock fragments increases with depth; pH 5.9.

B_{23} 46 to 51 inches, dark yellowish-brown to dark-brown (10YR 4/4 to 4/3, moist) clay loam; weak coarse subangular blocky structure; very firm; pH 7.2.

C 51 inches +, yellowish-brown or light olive-brown (10YR 5.4 to 2.5Y 5/4, moist) loam till; calcareous.

Miami soils have up to 17 inches of loess over material weathered from loam till. The till is calcareous at depths ranging from 24 to about 42 inches. Some areas of Miami soil have no loess over the weathered till.

Milton soil developed in deposits of glacial drift, 20 to 42 inches thick, that overlies bedrock.

Metea soil developed from 20 to about 40 inches of sandy outwash that overlies material weathered from light loam till. The till is calcareous at depths of 40 to 54 inches.

WELL-DRAINED TO SOMEWHAT EXCESSIVELY DRAINED GRAY-BROWN PODZOLIC SOILS.—The members of this group are the Fox, Ockley, and Oaktown soils.

Ockley soils have silty upper horizons that are underlain by stratified calcareous gravel and sand at depths of 42 to about 70 inches.

Representative profile of Ockley silt loam in a wooded area:

A_0 ½ to 0 inch, very dark brown partially decomposed leaves, twigs, and other forest debris; neutral.

A_1 0 to 3 inches, very dark grayish-brown (10YR 3/2, moist) silt loam; high organic-matter content; moderate fine granular structure; friable; slightly acid.

A_2 3 to 12 inches, yellowish-brown to pale-brown (10YR 5/4 to 6/3, moist) silt loam; moderate thin platy structure; friable; medium acid.

B_1 12 to 18 inches, yellowish-brown or dark yellowish-brown (10YR 5/4 to 4/4, moist) light silty clay loam; moderate fine subangular blocky structure; slightly firm; medium acid.

B_{21} 18 to 39 inches, dark-brown (7.5YR 4/4 to 10YR 4/3, moist) silty clay loam or clay loam; moderate medium

[6] Determination of pH made by colormetric method in the field.
[7] Munsell color notation.

subangular blocky structure; firm; content of sand and partially weathered rock fragments increases with depth; medium to strongly acid.

B_{22} 39 to 55 inches, dark yellowish-brown to dark-brown (10YR 4/4 to 4/3, moist) clay loam or sandy clay loam; weak coarse subangular blocky structure; firm; medium to strongly acid.

B_{23} 55 to 63 inches, dark grayish-brown (10YR 4/2, moist) clay loam to gravelly clay loam; weak very coarse subangular blocky structure; very firm; slightly acid to neutral.

D 63 inches +, pale-brown (10YR 6/3, moist) stratified gravel and sand; calcareous.

Fox soils developed from silty and loamy outwash, 24 to 42 inches thick, overlying calcareous stratified gravel and sand. They have thinner upper horizons than the Ockley soils.

Oaktown soil is excessively drained. It developed from loose mildly alkaline to slightly acid sand and loamy sand. The B horizons are very weakly developed and may occur as thin discontinuous bands.

IMPERFECTLY DRAINED GRAY-BROWN PODZOLIC SOILS —In this group are the Crosby, Fincastle, Homer, and Sleeth series.

Crosby, Fincastle, Homer, and Sleeth soils have the same kind and sequence of horizons as well-drained Gray-Brown Podzolic soils that developed in the same kinds of parent material. (See table 10). They differ from the well-drained soils in being mottled in the lower part of the A horizon or the upper part of the B horizon and in having a slightly higher maximum clay content in the B_2 horizon.

Gray-Brown Podzolic soils intergrading to Brunizems

Development of this group of soils probably began under prairie vegetation, but timber must have encroached long enough to change the profile characteristics from those normal for Brunizem soils. The lower part of the original A_1 horizon has been replaced by an A_2 horizon; thus, the present A_1 horizon is thinner than it would have been if forest had not encroached.

This group includes the excessively drained Longlois and the imperfectly drained Monitor soils.

Longlois soil developed on silty and loamy outwash, 42 to 70 inches thick, that overlies stratified calcareous gravel and sand.

Monitor soil is like the Longlois soil, except for having imperfect drainage rather than excessive drainage.

Humic Gley soils

Humic Gley soils have developed under poor to very poor natural drainage on nearly level areas or in depressed flats. Probably the dominant vegetation during development was sloughgrass, rushes, reeds, and sedges, and some forest species that encroached. The soils of this group are members of the Brookston, Kokomo, Cope, Millsdale, Westland, Abington, and Lyles series.

Brookston soil is representative of the Humic Gley great soil group. Following is a profile description of Brookston silty clay loam in a cultivated area:

A_p 0 to 8 inches; very dark brown to very dark grayish-brown (10YR 2/2 to 3/2, moist) silty clay loam; weak medium to coarse granular structure; firm; high organic-matter content; slightly acid to neutral.

A_{12} 8 to 14 inches, very dark brown (10YR 2/2, moist) silty clay loam, slightly mottled with yellowish brown (10YR 5/6, moist) in lower part; moderate very coarse granular to fine subangular blocky structure; firm; high organic-matter content but slight decrease with depth; slightly acid to neutral.

B_{21g} 14 to 25 inches, mottled grayish-brown (10YR 5/2, moist), yellowish-brown (10YR 5/8, moist), and light brownish-gray (10YR 6/2, moist) heavy silty clay loam or heavy clay loam; weak coarse prismatic or coarse angular blocky structure; very firm when moist, plastic and sticky when wet, and very hard when dry; neutral to mildly alkaline.

B_{22g} 25 to 50 inches, mottled yellowish-brown and light brownish-gray (10YR 5/8 and 6/2, moist) heavy clay loam; moderate coarse to very coarse blocky structure; very firm when moist, plastic when wet, and very hard when dry; mildly alkaline.

C 50 inches +, mottled light brownish-gray and yellowish-brown loam glacial till; calcareous.

Kokomo soil has a thicker and darker colored A_1 horizon than the Brookston, and the B_{g1} horizon is dominantly gray.

Cope soils have a thinner and somewhat lighter colored A_1 horizon than the Brookston soils. In this respect they could be considered as intergrading to Low-Humic Gley soils.

Westland soils have developed on medium-textured to moderately fine textured outwash that is underlain by stratified calcareous gravel and sand at depths of 40 to 60 inches or more.

Abington soil has developed from materials similar to those from which the Westland soils were formed, but it has a thicker and darker A_1 horizon that is higher in organic matter, and the B_{21g} horizon is dominantly gray.

Millsdale soil has developed from 20 to 42 inches of moderately fine textured to fine-textured glacial drift that overlies bedrock.

Lyles soil has developed on stratified sands.

Brown Forest soils

In the Brown Forest group are Nineveh and Farmington soils.

Nineveh soil has developed from loamy or silty outwash that is underlain by stratified calcareous gravel and sand at depths of 25 to 40 inches. The A_1 horizon is dark grayish brown to very dark grayish brown and is moderately high in organic matter. The B horizons are dark brown and have some concentration of clay. The entire solum is neutral in reaction. The dark-colored A_1 horizon and the textural B horizon indicate that Nineveh soil is transitional to the Brunizem great soil group.

Farmington soil has developed from 6 to 18 inches of medium-textured glacial drift that overlies limestone bedrock. Areas with the minimum thickness of drift are transitional to the Lithosol great soil group.

Rendzina soils

The Rendzina great soil group is represented by soils of the Hennepin and Rodman series.

Hennepin soil typically has a thin dark-colored A_1 horizon that overlies calcareous loam till. Severely eroded areas, where the calcareous till is on the surface, probably are better classified as Regosols. Areas that have slight development of the B horizon are transitional toward the Gray-Brown Podzolic great soil group.

Rodman soil has a 5- to 10-inch A_1 horizon that is dark colored, high in organic matter, and neutral to calcareous. The A_1 horizon is underlain by calcareous gravel and sand. Where the A_1 horizon has been eroded and the calcareous gravel and sand are exposed, this soil might be better classified as a Regosol.

Alluvial soils

The Alluvial soils are on first bottoms and are composed of material washed from areas of Wisconsin glacial drift. They still receive alluvium from floodwaters. The soils of this group are the Genesee, Eel, Sloan, Ross, and Washtenaw.

Genesee soils are well drained, light colored, neutral to alkaline, and have very little profile development.

Eel soils are like the Genesee, except they are moderately well drained.

Sloan soils are poorly to very poorly drained and have a thick dark-colored A_1 horizon and a mottled subsoil that shows slight accumulation of clay. Sloan soils are transitional to the Humic Gley great soil group.

Ross soils, on slightly higher elevation than the Genesee, have a dark-colored A_1 horizon up to 18 inches thick. In places, they show slight development of a B horizon.

Washtenaw soil is forming on light-colored alluvium or colluvium washed from uplands and terraces. The deposit of lighter colored material, 10 to 40 inches thick, has been laid down on soils that would have been classified as Humic Gley.

Organic soils

The soils of this group are the Carlisle, Linwood, and Edwards, all of which were derived from organic deposits.

Carlisle muck is a black, woody, well-decomposed, neutral to medium-acid muck overlying partially decomposed peaty material. The total thickness of the organic material is more than 42 inches.

Linwood muck has a black, mucky surface soil containing a high proportion of woody material. This material is underlain at depths of 12 to 42 inches by medium-textured mineral material.

Edwards muck consists of black, neutral muck that is underlain by gray marl at depths of 12 to 42 inches.

Soil Survey Methods and Definitions

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

FIELD STUDY.—The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern, but are located according to the lay of the land. Usually they are not more than a quarter of a mile apart and sometimes they are much closer. In most soils each boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about this soil that influence its capacity to support plant growth.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers, and is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture. Structure is defined in terms of distinctness, size, and shape of the soil aggregates. For example, "moderate medium subangular blocky" means moderately distinct, medium-sized aggregates of subangular blocky shape.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation. Consistence is described at three standard moisture contents—dry, moist, and wet. The consistence when moist is commonly the most significant. The terms friable and firm, when used without statement of moisture content, imply moist conditions. The term loose applies to noncoherent material.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying parent material from which the soil has developed; and acidity or alkalinity of the soil as measured by chemical tests.

CLASSIFICATION.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified into phases, types, and series. The soil type is the basic classification unit. A soil type may consist of several phases. Types that resemble each other in most of their characteristics are grouped into soil series.

As an example of soil classification, consider the

Ockley series of Carroll County. This series is made up of two soil types, subdivided into phases, as follows:

Series	Type	Phase
Ockley	loam	0 to 3 percent slopes.
		3 to 8 percent slopes.
		3 to 8 percent slopes, eroded.
	silt loam	0 to 3 percent slopes.
		3 to 8 percent slopes.
		3 to 8 percent slopes, eroded.

Soil type.—Soils similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, number of rock outcrops, degree of erosion, depth of soil over the substratum, or natural drainage, are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices therefore can be specified more easily for a phase than for a soil series or yet broader groups that contain more variation.

Soil series.—Two or more soil types that differ in surface texture, but are otherwise similar in kind, thickness, and arrangement of soil layers, are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which it was first mapped.

Miscellaneous land types.—Areas that have little true soil are not classified by types and series, but are identified by descriptive names, such as Gravel pits.

Catena.—A group of soils within one zonal region developed from similar parent material but under different kinds of drainage is called a catena. In this report, soil catenas are named for the first zonal soil (if it exists) on any given parent material, that is, for the first soil listed in a horizontal line in table 10. For example, soils said to be associated with soils of the Miami catena would occur with Miami, Crosby, Cope, Brookston, Kokomo, and Hennepin soils. Because of variation in the Brookston and Kokomo soils, they have been placed in both the Miami and Russell catenas. Because of differences in vegetative cover that have resulted in genesis of different zonal soils, two catenas, the Ockley and Longlois, are recognized on the same parent material.

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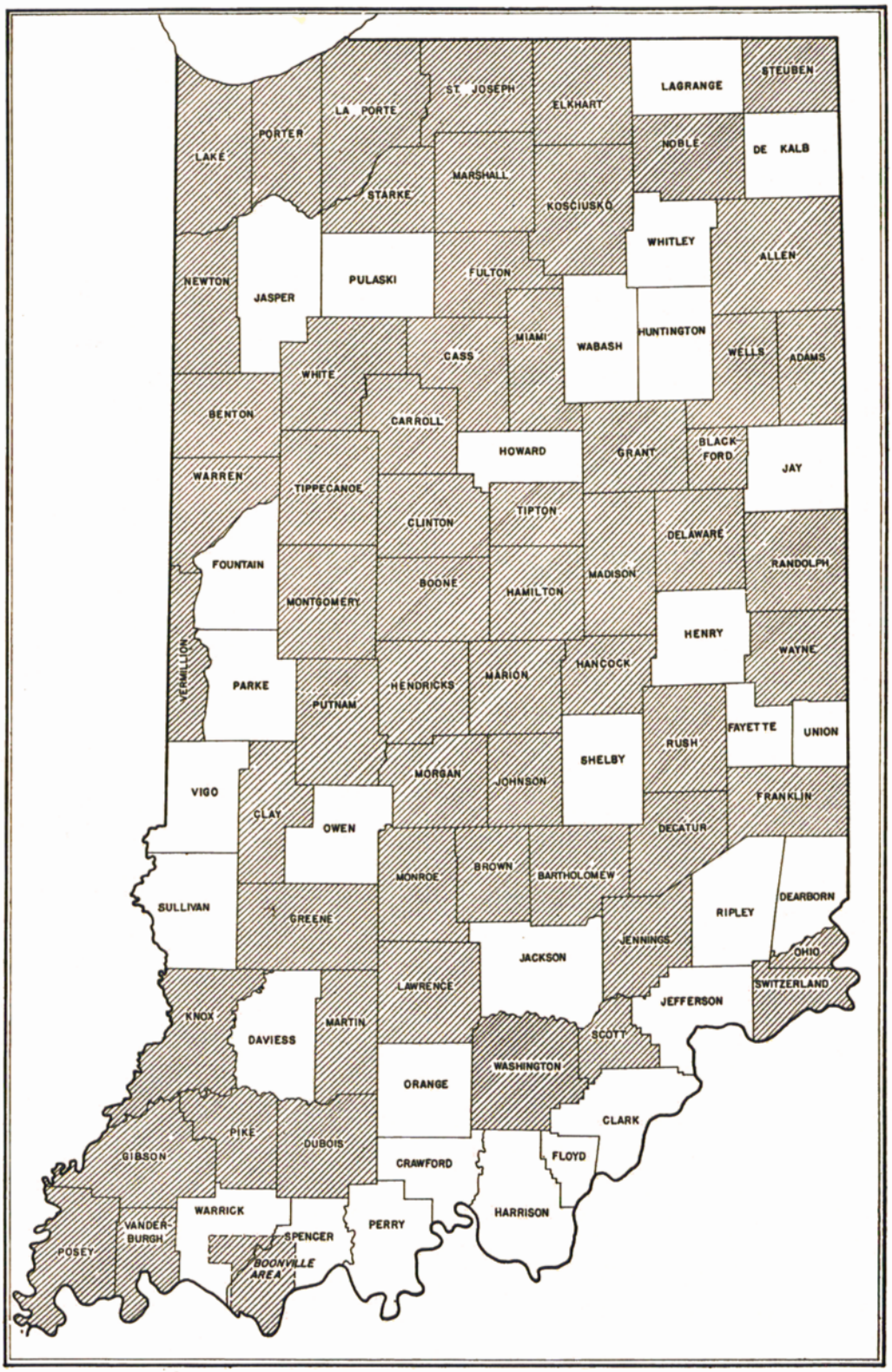
☆ U. S. GOVERNMENT PRINTING OFFICE: 1958—429180



Areas surveyed in Indiana shown by shading.

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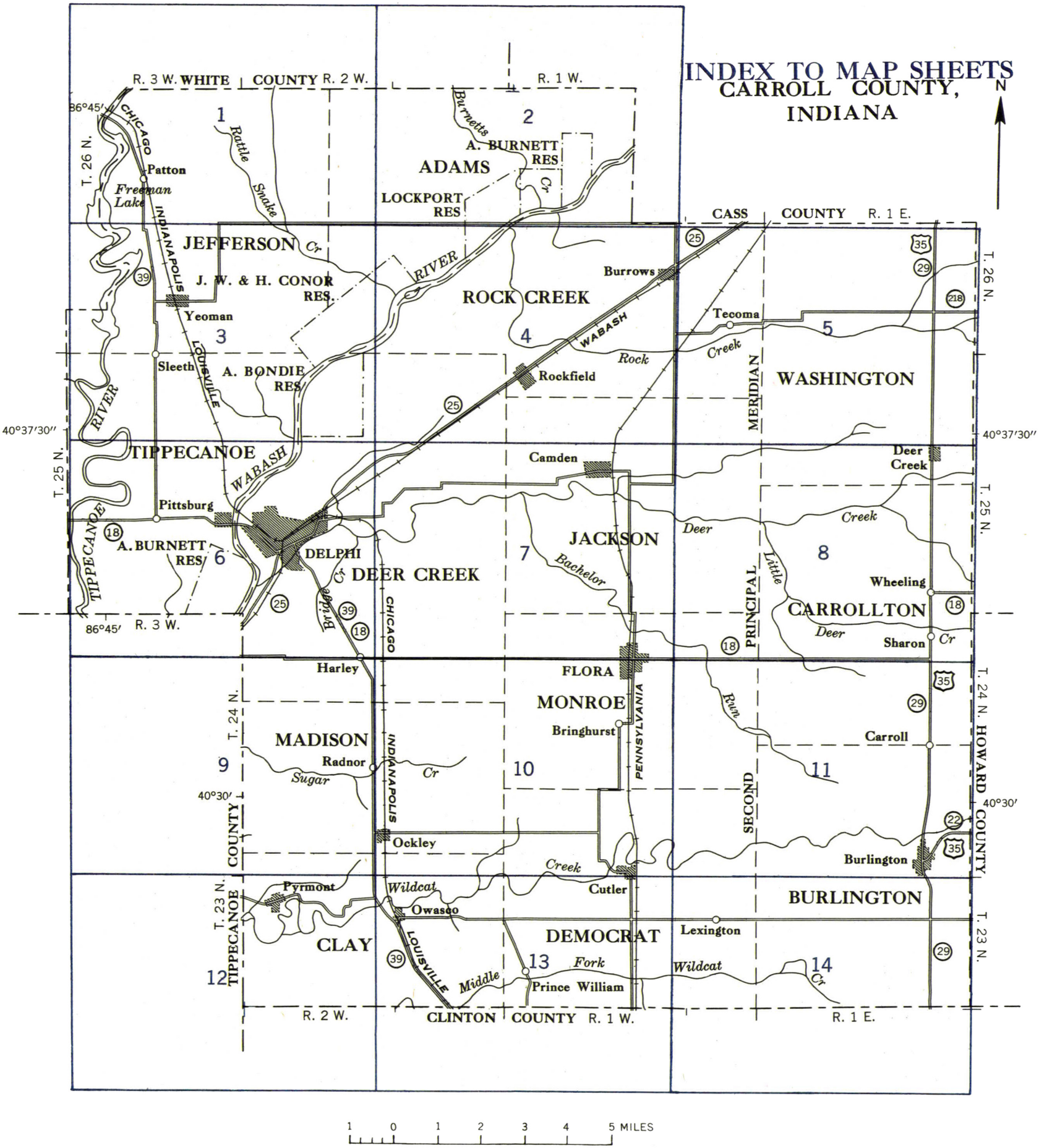
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CARROLL COUNTY,
INDIANA
N
R. 3 W.
WHITE COUNTY
R. 2 W.
R. 1 W.
CASS COUNTY
R. 1 E.
86°45′
40°37′30″
40°30′
T. 26 N.
T. 25 N.
T. 24 N.
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Little Deer Creek
Sugar Cr
Wildcat Creek
Middle Fork Wildcat Cr
CHICAGO INDIANAPOLIS LOUISVILLE
PENNSYLVANIA
PRINCIPAL MERIDIAN
SECOND
TIPPECANOE RIVER
1 0 1 2 3 4 5 MILES

SOILS LEGEND

SYMBOL	NAME
Aa	Abington silty clay loam, 0-3 percent slopes
Ba	Fox loam, 3-8 percent slopes, eroded kame phase
Bb	Fox loam, 8-25 percent slopes, eroded kame phase
Bc	Brookston silty clay loam, 0-3 percent slopes
Ca	Carlisle muck
Cb	Cope silt loam, 0-3 percent slopes
Cc	Cope silty clay loam, 0-3 percent slopes
Cd	Crosby silt loam, 0-3 percent slopes
Ea	Edwards muck
Eb	Eel loam, 0-3 percent slopes
Ec	Eel silt loam, 0-3 percent slopes
Ed	Eel silty clay loam, 0-3 percent slopes
Fa	Farmington silt loam, 0-4 percent slopes
Fb	Fincastle silt loam, 0-3 percent slopes
Fc	Fox loam and clay loam, 8-12 percent slopes, severely eroded
Fd	Fox loam and clay loam, 12-25 percent slopes, severely eroded
Fe	Fox fine sandy loam, 0-3 percent slopes
Ff	Fox loam, 0-3 percent slopes
Fg	Fox loam, 3-8 percent slopes, eroded
Fh	Fox loam, 8-12 percent slopes
Fk	Fox loam, 8-12 percent slopes, eroded
Fl	Fox loam, 12-25 percent slopes
Fm	Fox loam, 12-25 percent slopes, eroded
Fn	Fox silt loam, 0-3 percent slopes
Fo	Fox silt loam, 3-8 percent slopes
Fp	Fox loam, 3-8 percent slopes
Ga	Genesee fine sandy loam, 0-3 percent slopes
Gb	Genesee fine sandy loam, high bottom, 0-3 percent slopes
Gc	Genesee loam, 0-3 percent slopes
Gd	Genesee loam, high bottom, 0-3 percent slopes
Ge	Genesee silt loam, 0-3 percent slopes
Gf	Genesee silt loam, high bottom, 0-3 percent slopes
Ha	Hennepin loam, 25-65 percent slopes
Hb	Homer silt loam, 0-3 percent slopes
Ka	Kokomo silty clay loam, 0-3 percent slopes
La	Longlois silt loam, 0-3 percent slopes
Lb	Lyles loam, 0-3 percent slopes
Ma	Metea fine sandy loam, 3-8 percent slopes
Mb	Miami silt loam, 3-8 percent slopes
Mc	Miami silt loam, 3-8 percent slopes, eroded
Md	Miami silt loam, 8-12 percent slopes, eroded
Me	Miami silt loam, 12-18 percent slopes, eroded
Mf	Millsdale silty clay loam, 0-3 percent slopes
Mg	Milton silt loam, 0-5 percent slopes
Mh	Monitor silt loam, 0-3 percent slopes
Na	Nineveh loam, 0-3 percent slopes
Oa	Oaktown loamy fine sand, 3-10 percent slopes
Ob	Ockley loam, 0-3 percent slopes
Oc	Ockley loam, 3-8 percent slopes
Od	Ockley loam, 3-8 percent slopes, eroded
Oe	Ockley silt loam, 0-3 percent slopes
Of	Ockley silt loam, 3-8 percent slopes
Og	Ockley silt loam, 3-8 percent slopes, eroded
Ra	Rodman gravelly loam, 25-60 percent slopes
Rb	Ross loam, 0-3 percent slopes
Rc	Ross silt loam, 0-3 percent slopes
Rd	Ross silty clay loam, 0-3 percent slopes
Re	Russell silt loam, 0-3 percent slopes
Rf	Russell silt loam, 3-8 percent slopes
Rg	Russell silt loam, 3-8 percent slopes, eroded
Rh	Russell silt loam, 8-12 percent slopes
Rk	Russell silt loam, 8-12 percent slopes, eroded
Rl	Russell silt loam, 12-25 percent slopes
Rm	Russell silt loam, 12-25 percent slopes, eroded
Rn	Russell silt loam and silty clay loam, 3-8 percent slopes, severely eroded
Ro	Russell silt loam and silty clay loam, 8-12 percent slopes, severely eroded
Rp	Russell silt loam and silty clay loam, 12-25 percent slopes, severely eroded
Sa	Sleeth silt loam, 0-3 percent slopes
Sb	Sloan silt loam, 0-3 percent slopes
Sc	Sloan silty clay loam, 0-3 percent slopes
Wa	Washtenaw silt loam, 0-3 percent slopes
Wb	Westland loam, 0-3 percent slopes
Wc	Westland silt loam, 0-3 percent slopes
Wd	Westland silty clay loam, 0-3 percent slopes
We	Linwood muck
⚒	Gravel pits

COLOR GROUPING

WELL DRAINED AND EXCESSIVELY DRAINED SOILS

STEEP AND MODERATELY STEEP SOILS OF UPLANDS

Ha	Hennepin loam, 25-65 percent slopes
Me	Miami silt loam, 12-18 percent slopes, eroded
Rl	Russell silt loam, 12-25 percent slopes
Rm	Russell silt loam, 12-25 percent slopes, eroded
Rp	Russell silt loam and silty clay loam, 12-25 percent slopes, severely eroded

STEEP AND MODERATELY STEEP SOILS OF TERRACES

Bb	Fox loam, 8-25 percent slopes, eroded kame phase
Fd	Fox loam and clay loam, 12-25 percent slopes, severely eroded
Fl	Fox loam, 12-25 percent slopes
Fm	Fox loam, 12-25 percent slopes, eroded
Ra	Rodman gravelly loam, 25-60 percent slopes

MISCELLANEOUS LAND TYPES

⚒	Gravel pits

WELL DRAINED SOILS

SLOPING SOILS OF UPLANDS

Md	Miami silt loam, 8-12 percent slopes, eroded
Rh	Russell silt loam, 8-12 percent slopes
Rk	Russell silt loam, 8-12 percent slopes, eroded
Ro	Russell silt loam and silty clay loam, 8-12 percent slopes, severely eroded

SLOPING SOILS AND ERODED GENTLY SLOPING SOILS OF TERRACES

Ba	Fox loam, 3-8 percent slopes, eroded kame phase
Fc	Fox loam and clay loam, 8-12 percent slopes, severely eroded
Fg	Fox loam, 3-8 percent slopes, eroded
Fh	Fox loam, 8-12 percent slopes
Fk	Fox loam, 8-12 percent slopes, eroded
Oa	Oaktown loamy fine sand, 3-10 percent slopes
Od	Ockley loam, 3-8 percent slopes, eroded
Og	Ockley silt loam, 3-8 percent slopes, eroded

LEVEL AND GENTLY SLOPING DEEP-LEACHED SOILS OF TERRACES AND OUTWASH PLAINS

La	Longlois silt loam, 0-3 percent slopes
Ob	Ockley loam, 0-3 percent slopes
Oc	Ockley loam, 3-8 percent slopes
Oe	Ockley silt loam, 0-3 percent slopes
Of	Ockley silt loam, 3-8 percent slopes

LEVEL AND GENTLY SLOPING SHALLOW-LEACHED SOILS OF TERRACES AND OUTWASH PLAINS

Fe	Fox fine sandy loam, 0-3 percent slopes
Ff	Fox loam, 0-3 percent slopes
Fn	Fox silt loam, 0-3 percent slopes
Fo	Fox silt loam, 3-8 percent slopes
Fp	Fox loam, 3-8 percent sopes
Na	Nineveh loam, 0-3 percent slopes

LEVEL AND GENTLY SLOPING DEEP-LEACHED SOILS OF UPLANDS

Ma	Metea fine sandy loam, 3-8 percent slopes
Re	Russell silt loam, 0-3 percent slopes
Rf	Russell silt loam, 3-8 percent slopes
Rg	Russell silt loam, 3-8 percent slopes, eroded
Rn	Russell silt loam and silty clay loam, 3-8 percent slopes, severely eroded

LEVEL AND GENTLY SLOPING SHALLOW-LEACHED SOILS OF UPLANDS

Fa	Farmington silt loam, 0-4 percent slopes
Mb	Miami silt loam, 3-8 percent slopes
Mc	Miami silt loam, 3-8 percent slopes, eroded
Mg	Milton silt loam, 0-5 percent slopes

LEVEL SOILS OF BOTTOM LANDS

Ga	Genesee fine sandy loam, 0-3 percent slopes
Gb	Genesee fine sandy loam, high bottom, 0-3 percent slopes
Gc	Genesee loam, 0-3 percent slopes
Gd	Genesee loam, high bottom, 0-3 percent slopes
Ge	Genesee silt loam, 0-3 percent slopes
Gf	Genesee silt loam, high bottom, 0-3 percent slopes
Rb	Ross loam, 0-3 percent slopes
Rc	Ross silt loam, 0-3 percent slopes
Rd	Ross silty clay loam, 0-3 percent slopes

MODERATELY WELL DRAINED SOILS

LEVEL SOILS OF BOTTOM LANDS

Eb	Eel loam, 0-3 percent slopes
Ec	Eel silt loam, 0-3 percent slopes
Ed	Eel silty clay loam, 0-3 percent slopes

IMPERFECTLY DRAINED SOILS

LEVEL SOILS OF UPLANDS

Cd	Crosby silt loam, 0-3 percent slopes
Fb	Fincastle silt loam, 0-3 percent slopes

LEVEL SOILS OF TERRACES

Hb	Homer silt loam, 0-3 percent slopes
Mh	Monitor silt loam, 0-3 percent slopes
Sa	Sleeth silt loam, 0-3 percent slopes

POORLY DRAINED AND VERY POORLY DRAINED SOILS

LEVEL AND DEPRESSED SOILS OF UPLANDS

Bc	Brookston silty clay loam, 0-3 percent slopes
Cb	Cope silt loam, 0-3 percent slopes
Cc	Cope silty clay loam, 0-3 percent slopes
Ka	Kokomo silty clay loam, 0-3 percent slopes
Wa	Washtenaw silt loam, 0-3 percent slopes

LEVEL AND DEPRESSED SOILS OF TERRACES

Aa	Abington silty clay loam, 0-3 percent slopes
Lb	Lyles loam, 0-3 percent slopes
Mf	Millsdale silty clay loam, 0-3 percent slopes
Sb	Sloan silt loam, 0-3 percent slopes
Sc	Sloan silty clay loam, 0-3 percent slopes
Wb	Westland loam, 0-3 percent slopes
Wc	Westland silt loam, 0-3 percent slopes
Wd	Westland silty clay loam, 0-3 percent slopes

LEVEL ORGANIC SOILS

Ca	Carlisle muck
Ea	Edwards muck
We	Linwood muck

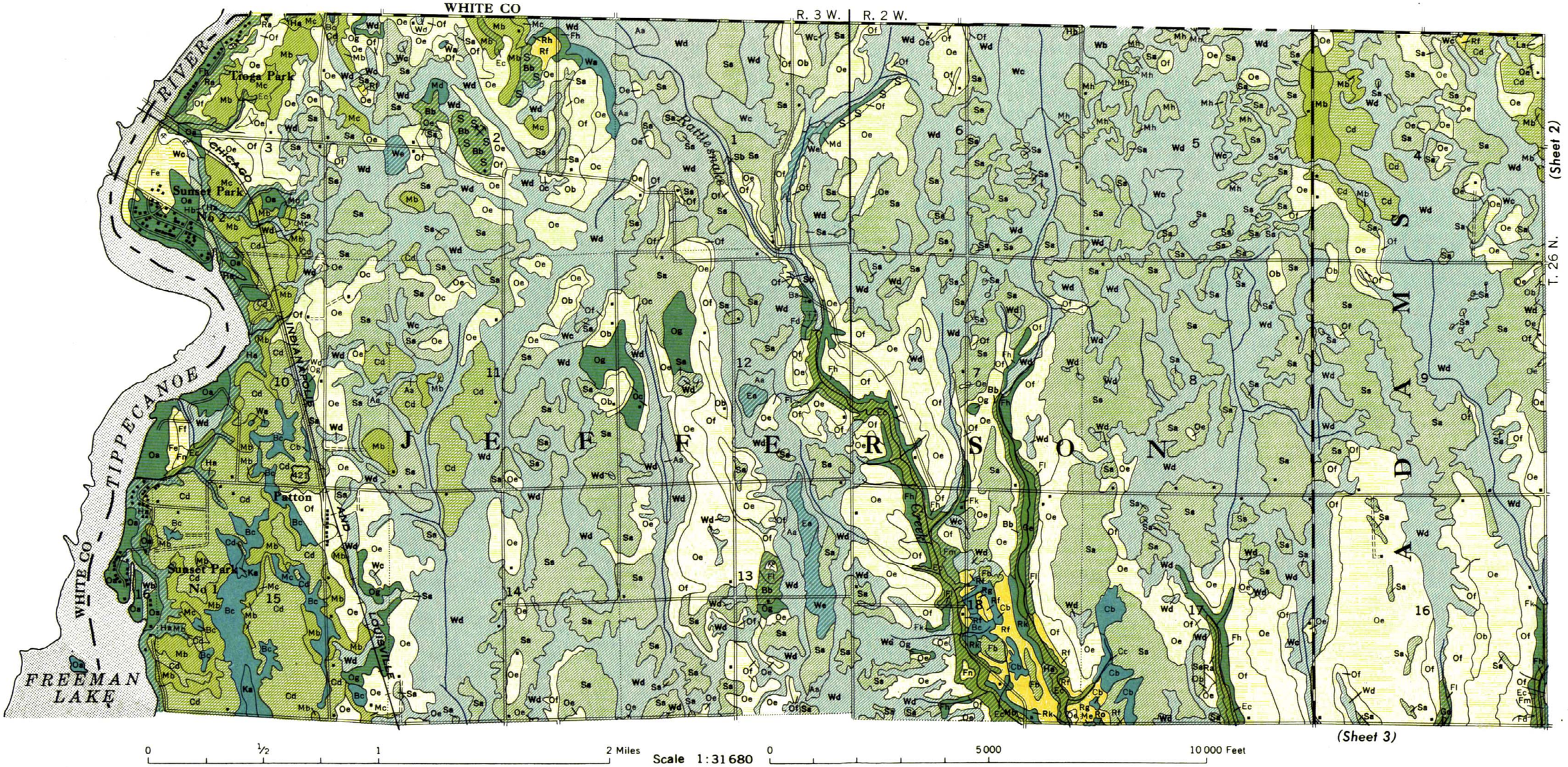
Soils surveyed 1939-40 by A. P. Bell, H. P. Ulrich, T. E. Barnes, and Sutton Myers, Purdue University Agricultural Experiment Station, and J. G. Wade, U. S. Department of Agriculture. Correlation by James Thorp, U. S. Department of Agriculture.

Soil map constructed 1954 by Cartographic Division, Soil Conservation Service, USDA, from 1952 aerial photographs. Map based on polyconic projection, 1927 North American datum.

CARROLL COUNTY, INDIANA

1

N



N

WHITE CO

R. 2 W.

R. 1 W.

CASS CO

(Sheet 1)

T. 26 N.

ADAMS

BURNETT

RESERVE

ZICOTT

RIVER

LIBERTY

CHILDREN OF ZICOTT RESERVE

Lockport

WABASH

ROCK CREEK

CASS CO

(Sheet 4)

0 ½ 1 2 Miles

Scale 1:31 680

0 5000 10 000 Feet

CARROLL COUNTY, INDIANA

R. 3 W. R. 2 W.

(Sheet 1)

N

FREEMAN LAKE

Roth Park

CHICAGO

JEFFERSON

ADAMS

Creek

Yeoman

INDIANAPOLIS

Oakdale Beach

OAKDALE DAM HYDROELECTRIC PLANT

WHITE CO

T. 26 N.

T. 25 N.

Sleeth

421

WABASH AND ERIE CANAL

JACKSON RIVER

TIPPECANOE

Tippecanoe River

Louisville

ABONDIE RESERVE

DEER CREEK

(Sheet 4)

(Sheet 6)

0 ½ 1 2 Miles

Scale 1:31 680

0 5000 10 000 Feet

CARROLL COUNTY, INDIANA

(4)

N

(Sheet 2)

R. 2 W. | R. 1 W.

CASS CO

CHILDREN OF ZICOTT RESERVE

ADAMS

WABASH RIVER

Rattle Snake Creek

J WAND

H CONOR RESERVE

ROCK CREEK

ROCK CREEK

LIBERTY

Burrows

Rockfield

Flax

DEER CREEK

JACKSON

WABASH

PENNSYLVANIA

(Sheet 3)

(Sheet 5)

(Sheet 7)

T. 26 N.

T. 25 N.

0 ½ 1 2 Miles

Scale 1:31 680

0 5 000 10 000 Feet

CASS CO

R. 1 W. | R. 1 E.

5

N

T. 26 N.

T. 25 N.

(Sheet 4)

(Sheet 8)

CASS CO

WABASH

PENNSYLVANIA

SECOND PRINCIPAL MERIDIAN

ROCK CREEK

Paint Creek

Rock Creek

Tecoma

Mt Pisgah Church

LIMESTONE QUARRY

LIBERTY

WASHINGTON

JACKSON

0 ½ 1 2 Miles

Scale 1:31680

0 5000 10000 Feet

CARROLL COUNTY, INDIANA

(6)

N

(Sheet 3)

R. 3 W. | R. 2 W.

TIPPECANOE RIVER

CHICAGO

WABASH

INDIANAPOLIS

OLD

CANAL

AND

LOUISVILLE

WABASH

RIVER

DEER

Creek

Bridge

T I P P E C A N O E

A BURNETT RESERVE

Pittsburg

DELPHI

DEER CREEK

COUNTY FARM

Harley

TIPPECANOE

WHITE CO

TIPPECANOE CO

T. 24 N. | T. 25 N.

(Sheet 7)

(Sheet 9)

0 ½ 1 2 Miles

Scale 1:31 680

0 5 000 10 000 Feet

CARROLL COUNTY, INDIANA

R. 2 W. | R. 1 W.

(Sheet 4)

7

N

(Sheet 6)

(Sheet 8)

T. 25 N.

T. 24 N.

Camden

Lower Deer Creek Church

Flora

(Sheet 10)

WABASH

DEER CREEK

Deer Creek

Burlington

Pawn

Pawn Creek

CHICAGO

INDIANA POLIS AND LOUISVILLE

PENNSYLVANIA

JACKSON

DEER CREEK

MONROE

0 ½ 1 2 Miles

Scale 1:31 680

0 5 000 10 000 Feet

(8)

(Sheet 5)

R. 1 W. | R. 1 E.

N

WASHINGTON

CARROLL TON

JACKSON

MONROE

Deer Creek

Deer Creek Church

Wheeling

Sharon

Paint Creek

DEER CREEK

MERIDIAN

SECOND

CARROLL CO

HOWARD CO

T. 25 N.

T. 24 N.

(Sheet 7)

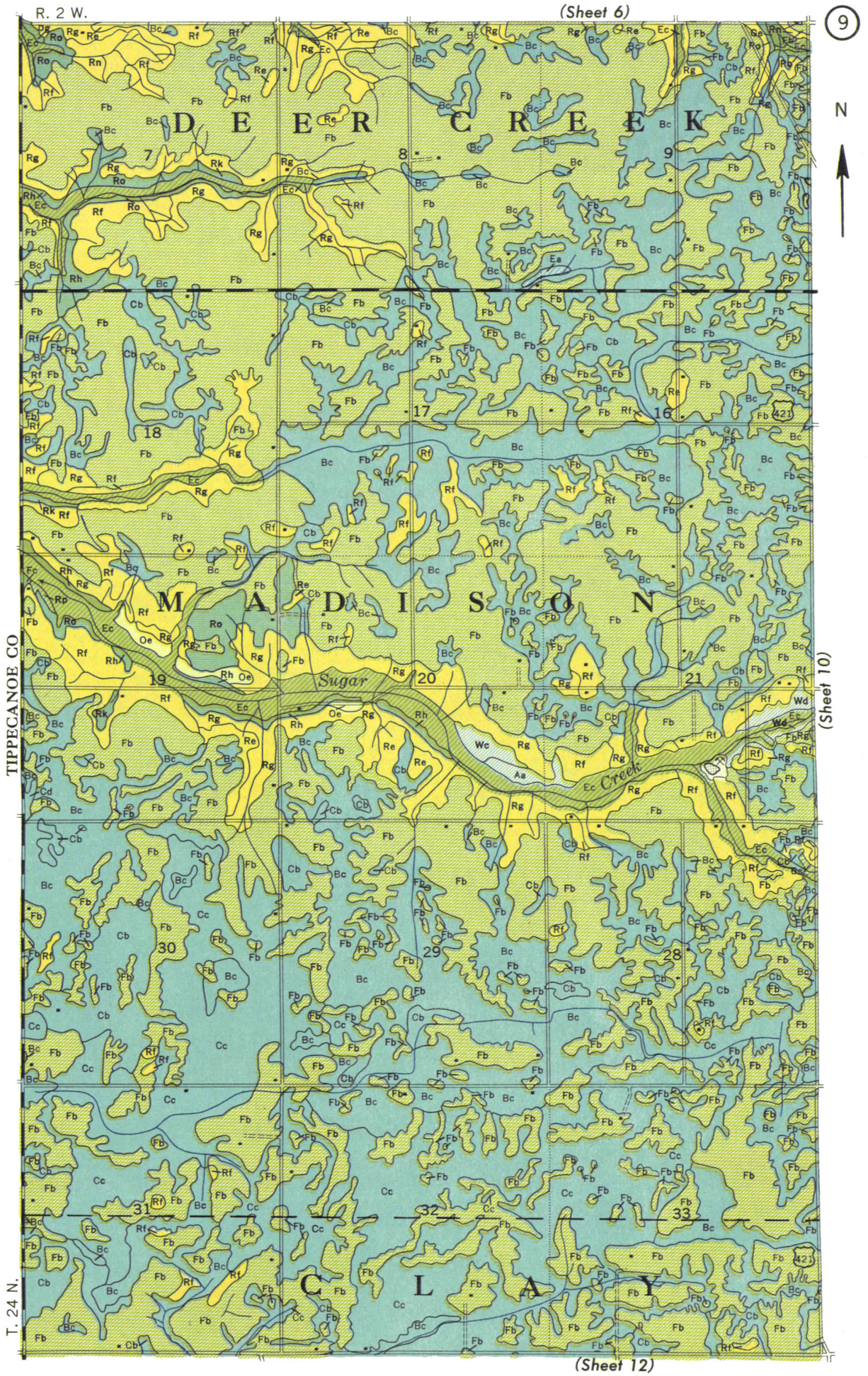
(Sheet 11)

Bachelor Fork

0 ½ 1 2 Miles

Scale 1:31 680

0 5000 10 000 Feet



0 ½ 1 2 Miles

Scale 1:31 680

0 5000 10 000 Feet

(10)

(Sheet 7)

R. 2 W. R. 1 W.

N

DEER CREEK

MONROE

MADISON

CLAY

DEMOCRAT

Flora

Bringhurst

Radnor

Ockley

Cutler

Creek

Bridge

Sugar

Wildcat

Creek

LOUISVILLE

INDIANAPOLIS

CHICAGO

PENNSYLVANIA

(Sheet 9)

(Sheet 11)

(Sheet 13)

T. 24 N.

0 ½ 1 2 Miles

Scale 1:31 680

0 5000 10 000 Feet

CARROLL COUNTY, INDIANA

R. 1 W. R. 1 E.

(Sheet 8)

11

N

MAPLE LAWN CEMETERY

MONROE

CARROLLTON

DEMOCRAT

BURLINGTON

PRINCIPAL MERIDIAN

SECOND

Carroll

Bachelor Run

Wildcat Creek

Burlington

(Sheet 10)

T. 24 N.

HOWARD CO

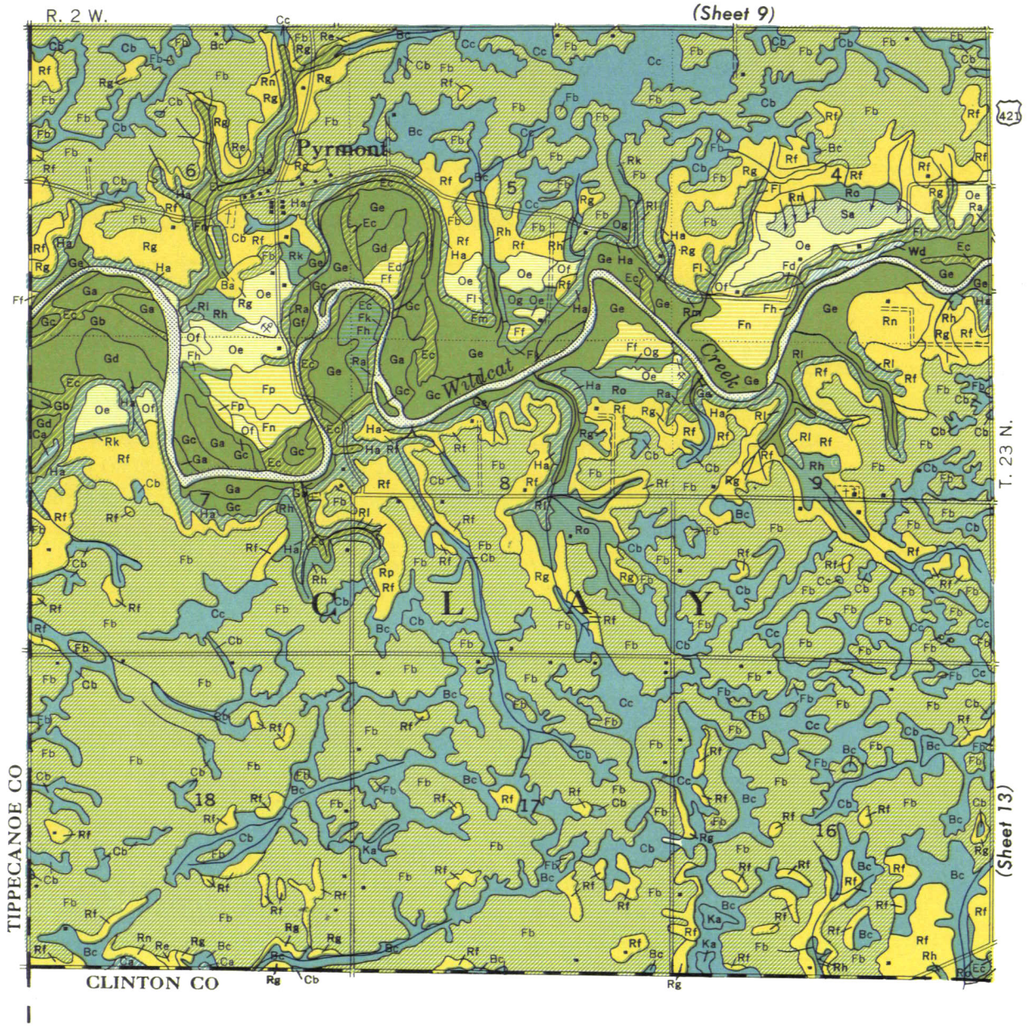
(Sheet 14)

0 1/2 1 2 Miles

Scale 1:31 680

0 5000 10 000 Feet

N



0 ½ 1 2 Miles

Scale 1:31 680

0 5 000 10 000 Feet

CARROLL COUNTY, INDIANA

R. 2 W. | R. 1 W.

(Sheet 10)

13

N

T. 23 N.

(Sheet 12)

(Sheet 14)

CLAY

DEMOCRAT

Owasco

Prince William

Middle Fork Wildcat Creek

Wildcat Creek

CHICAGO

INDIANAPOLIS AND LOUISVILLE

PENNSYLVANIA

CLINTON CO

421

0 ½ 1 2 Miles

Scale 1:31 680

0 5000 10 000 Feet

(14)

(Sheet 11)

R. 1 W. R. 1 E.

N

DEMOCRAT

BURLINGTON

Lexington

PRINCIPAL MERIDIAN

SECOND

Middle Fork Wildcat Creek

T. 23 N.

HOWARD CO

CLINTON CO

(Sheet 13)

0 ½ 1 2 Miles

Scale 1:31 680

0 5000 10 000 Feet

CARROLL COUNTY, INDIANA
CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Roads

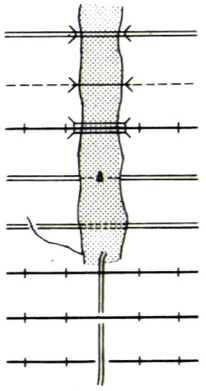
- Good motor
- Poor motor
- Trail
- Marker, U. S. (33)

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail, foot
- Railroad
- Ferry
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel



- Buildings
- School
- Church
- Station
- Mine and Quarry
- Shaft
- Dump
- Prospect
- Pits, gravel or other
- Power line
- Pipeline
- Cemetery
- Dam
- Levee
- Tank
- Oil well
- Windmill
- Canal lock (point upstream)

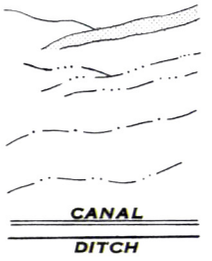
BOUNDARIES

- National or state
- County
- Township, civil
- U. S.
- Section
- City (corporate)
- Reservation
- Land grant

DRAINAGE

Streams

- Perennial
- Intermittent, unclass.
- Crossable with tillage implements
- Not crossable with tillage implements



- Canals and ditches

Lakes and ponds

- Perennial
- Intermittent
- Wells
- Springs
- Marsh
- Wet spot

RELIEF

Escarpments

- Bedrock
- Other
- Prominent peaks

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil type outline and symbol (Dx)
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land

Erosion

- Uneroded spot (U)
- Sheet, moderate (S)
- Sheet, severe (SS)
- Gully, moderate (G)
- Gully, severe (GG)
- Sheet and gully, moderate (SG)
- Wind, moderate
- Wind, severe
- Blowout
- Wind hummock
- Overblown soil

Gullies

- Crossable with tillage implements
- Not crossable with tillage implements

Areas of alkali and salts

- Strong (A)
- Moderate (M)
- Slight (S)
- Free of toxic effect (F)
- Sample location (26)
- Saline spot

SOILS OF CARROLL COUNTY, INDIANA: SUMMARY OF IMPORTANT CHARACTERISTICS

Soil	Topography	Parent or underlying material	Surface soil	Subsoil	Acidity		Natural soil drainage	Permeability	Surface runoff	Susceptibility to erosion	Moisture-supplying capacity	General productivity
					Surface	Subsurface						
Abington silty clay loam, 0 to 3 percent slopes.	Deeper depressions on outwash terraces; often former stream channels.	Medium to moderately fine textured outwash, 42 to 65 inches thick, over calcareous stratified gravel and sand.	Very dark gray to black silty clay loam.	Gray silty clay loam, with some yellowish-brown mottling.	Slightly acid to neutral.	Neutral	Very poor	Slow	Very slow to ponded.	None	Very high	Very high.
Brookston silty clay loam, 0 to 3 percent slopes.	Upland swales and depressed flats.	Highly calcareous loam till	Very dark grayish-brown silty clay loam.	Mottled gray and yellowish-brown silty clay loam.	Same	Neutral	Very poor	Slow	Same	None	Very high	Very high.
Carlisle muck	Former lakes, ponds, and marshes.	Decomposed mosses, sedges, woody material.	Black granular muck	Dark-brown fibrous and woody muck to peat.	Medium to slightly acid.	Medium to slightly acid.	Very poor	Moderately rapid.	Same	Slight wind erosion.	High to very high.	High to very high.
Cope silt loam, 0 to 3 percent slopes.	Shallow depressions in upland.	Highly calcareous loam till	Dark-gray to very dark gray silt loam.	Mottled gray and yellowish-brown silty clay loam.	Same	Slightly acid to neutral.	Poor to very poor	Slow	Very slow	None	High to very high.	High to very high.
Cope silty clay loam, 0 to 3 percent slopes.	Same	Highly calcareous loam till	Dark-gray to very dark gray silty clay loam.	Same	Same	Same	Poor to very poor	Slow	Very slow	None	High to very high.	High to very high.
Crosby silt loam, 0 to 3 percent slopes.	Nearly level to gently undulating upland.	Highly calcareous loam till	Grayish-brown silt loam	Same	Medium acid.	Medium to strongly acid.	Imperfect	Slow	Slow	Slight	High	High.
Edwards muck	Former lakes and marshes; depressed flats.	Decomposed mosses, sedges, etc., 12 to 42 inches thick, over gray marl.	Black granular muck	Dark-brown fibrous to woody muck.	Slightly acid to neutral.	Neutral to alkaline.	Very poor	Moderately rapid.	None	Slight wind erosion.	Very high	Medium to high.
Eel loam, 0 to 3 percent slopes.	Swales and meander channels of larger streams; first bottom of small streams.	Neutral to calcareous alluvium from timbered Wisconsin drift.	Grayish-brown loam	Yellowish-brown loam; mottled with gray at 15 to 30 inches.	Neutral to alkaline.	Neutral to alkaline.	Moderately well drained.	Moderate	Very slow	Slight stream bank erosion.	High to very high.	High to very high.
Eel silt loam, 0 to 3 percent slopes.	Same	Same	Grayish-brown silt loam	Same	Neutral to alkaline.	Neutral to alkaline.	Same	Moderate	Very slow	Same	High to very high.	High to very high.
Eel silty clay loam, 0 to 3 percent slopes.	Same	Same	Grayish-brown silty clay loam.	Same	Neutral to alkaline.	Neutral to alkaline.	Same	Moderate	Very slow	Same	High to very high.	High to very high.
Farmington silt loam, 0 to 4 percent slopes.	Rock-cut terraces along larger streams.	Glacial drift, 6 to 24 inches thick, over limestone.	Dark grayish-brown silt loam.	Dark-brown silt loam to light silty clay loam.	Neutral to alkaline.	Neutral to alkaline.	Well	Moderate	Slow to medium.	Slight to moderate.	Low	Low.
Fincastle silt loam, 0 to 3 percent slopes.	Level to gently undulating upland.	18 to 36 inches of loess over loam till; calcareous till at 42 to 60 inches.	Grayish-brown silt loam	Mottled gray and yellowish-brown silty clay loam.	Medium to slightly acid.	Strongly acid.	Imperfect	Slow	Slow	Slight	High	High.
Fox fine sandy loam, 0 to 3 percent slopes.	Outwash and stream terraces.	Loamy and sandy outwash, 30 to 44 inches thick, over calcareous gravel and sand.	Light-brown to grayish-brown fine sandy loam.	Dark yellowish-brown to brown sandy clay loam.	Same	Medium acid.	Well to somewhat excessive.	Moderately rapid.	Slight	Slight	Medium to low.	Medium.
Fox loam, 0 to 3 percent slopes.	Same	Loamy outwash, 24 to 42 inches thick, over calcareous gravel and sand.	Brown to grayish-brown loam.	Dark yellowish-brown to brown clay loam.	Same	Medium acid.	Same	Moderately rapid.	Slight	Slight	Medium to low.	Medium.
Fox loam, 3 to 8 percent slopes.	Same	Same	Same	Same	Same	Medium acid.	Same	Moderately rapid.	Medium	Moderate	Medium to low.	Medium.
Fox loam, 3 to 8 percent slopes, eroded.	Sloping areas around kettle holes and streams.	Same	Grayish-brown loam to yellowish-brown heavy loam.	Dark yellowish-brown to dark-brown clay loam.	Same	Medium acid.	Same	Moderately rapid.	Medium to rapid.	Moderate	Medium to low.	Medium.
Fox loam, 8 to 12 percent slopes.	Same	Same	Same	Same	Same	Medium acid.	Somewhat excessive.	Moderately rapid.	Rapid	Moderate to high.	Low	Low.
Fox loam, 8 to 12 percent slopes, eroded.	Same	Same	Yellowish-brown to brown loam to clay loam.	Same	Same	Medium acid.	Same	Rapid	Rapid	Moderate to high.	Low	Low.
Fox loam, 3 to 8 percent slopes, eroded kame phase.	Gently sloping areas on kames and knolls of upland.	Same	Brown heavy loam to yellowish-brown clay loam.	Same	Same	Medium acid.	Same	Moderately rapid.	Medium to rapid.	Moderate	Medium	Medium.
Fox loam, 8 to 25 percent slopes, eroded kame phase.	Sloping and strongly sloping areas on kames and knolls of upland.	Same	Grayish-brown loam to yellowish-brown gravelly clay loam.	Same	Same	Medium acid.	Same	Rapid	Rapid	Moderate to high.	Low	Low.

SOILS OF CARROLL COUNTY, INDIANA: SUMMARY OF IMPORTANT CHARACTERISTICS—*CONTINUED*

Soil	Topography	Parent or underlying material	Surface soil	Subsoil	Acidity		Natural soil drainage	Permeability	Surface runoff	Susceptibility to erosion	Moisture-supplying capacity	General productivity
					Surface	Subsurface						
Fox loam and clay loam, 8 to 12 percent slopes, severely eroded.	Sloping areas around kettle holes and streams.	Same	Yellowish-brown clay loam.	Same	Medium acid.	Medium acid.	Same	Rapid	Rapid	High	Low to very low.	Low to very low.
Fox loam and clay loam, 12 to 25 percent slopes, severely eroded.	Strongly sloping areas on terrace edges.	Same	Same	Same	Medium acid.	Medium acid.	Same	Rapid	Very rapid	High	Low to very low.	Very low.
Fox loam, 12 to 25 percent slopes.	Same	Same	Brown to grayish-brown loam.	Same	Medium to slightly acid.	Medium acid.	Same	Rapid	Very rapid	High	Low to very low.	Very low.
Fox loam, 12 to 25 percent slopes, eroded.	Same	Same	Brown heavy loam to yellowish-brown clay loam.	Same	Same	Medium acid.	Same	Rapid	Very rapid	High	Low to very low.	Very low.
Fox silt loam, 0 to 3 percent slopes.	Nearly level to gently sloping areas on terraces.	Silty and loamy outwash, 30 to 44 inches thick, over calcareous gravel and sand.	Grayish-brown to brown silt loam.	Dark yellowish-brown silty clay loam.	Same	Medium acid.	Well drained.	Moderate	Slight	Slight	Medium	Medium.
Fox silt loam, 3 to 8 percent slopes.	Sloping areas on terraces.	Same	Same	Same	Same	Medium acid.	Well drained.	Moderate	Slight to medium.	Slight to moderate.	Medium to low.	Medium.
Genesee fine sandy loam, 0 to 3 percent slopes.	Nearly level, slightly elevated natural levees.	Neutral to calcareous sandy alluvium from timbered Wisconsin drift areas.	Grayish-brown to pale-brown fine sandy loam.	Yellowish-brown fine sandy loam.	Neutral to calcareous.	Neutral to calcareous.	Well drained.	Moderately rapid.	Slight	None	Medium	Medium.
Genesee fine sandy loam, high bottom, 0 to 3 percent slopes.	Same	Same	Same	Same	Same	Same	Well drained.	Moderately rapid.	Slight	None	Medium	Medium.
Genesee loam, 0 to 3 percent slopes.	Same	Neutral to calcareous loamy alluvium from timbered Wisconsin drift areas.	Grayish-brown to dark grayish-brown loam.	Yellowish-brown loam	Same	Same	Well drained.	Moderate	Slight	None	High to very high.	High.
Genesee loam, high bottom, 0 to 3 percent slopes.	Same	Same	Yellowish-brown to brown loam.	Yellowish-brown loam	Same	Same	Well drained.	Moderate	Slight	None	High to very high.	High.
Genesee silt loam, 0 to 3 percent slopes.	Same	Neutral to calcareous silty alluvium from timbered Wisconsin drift areas.	Yellowish-brown to brown silt loam.	Yellowish-brown silt loam	Same	Same	Well drained.	Moderate	Slight	None	Very high	Very high.
Genesee silt loam, high bottom, 0 to 3 percent slopes.	Same	Same	Same	Same	Neutral	Neutral	Well drained.	Moderate	Slight	None	Very high	Very high.
Hennepin loam, 25 to 65 percent slopes.	Steep to very steep slopes on upland.	Highly calcareous loam till of Wisconsin age.	Very dark grayish-brown loam to silt loam.	Yellowish-brown heavy silt loam.	Neutral to mildly alkaline.	Mildly alkaline to calcareous.	Excessive	Slow	Very rapid	High to very high.	Low	Very low.
Homer silt loam, 0 to 3 percent slopes.	Level to slightly depressed areas on terraces.	Loamy and silty outwash, 30 to 44 inches thick, over calcareous gravel and sand.	Grayish-brown silt loam	Mottled gray and yellowish-brown clay loam.	Medium to slightly acid.	Medium to strongly acid.	Imperfect	Moderate to slow.	Slow	Slight	Medium	Medium.
Kokomo silty clay loam, 0 to 3 percent slopes.	Deeper depressions, intermittent ponds in upland.	Highly calcareous loam till of Wisconsin age.	Very dark gray to black silty clay loam.	Gray silty clay loam	Neutral	Neutral	Very poor	Slow	Very slow to ponded.	None	High to very high.	High to very high.
Linwood muck	Level to depressional areas.	Decomposed organic material, 12 to 42 inches thick, over medium-textured mineral material.	Black granular muck	Very dark gray muck; medium-textured mineral material at 12 to 42 inches.	Medium to slightly acid.	Medium acid to neutral.	Very poor	Moderate	Very slow to ponded.	Slight wind erosion.	High	High.
Longlois silt loam, 0 to 3 percent slopes.	Nearly level to gently sloping high outwash terraces.	Silty outwash, 42 to 70 inches thick, over calcareous gravel and sand.	Very dark grayish-brown to dark-brown silt loam.	Yellowish-brown to dark-brown silty clay loam to clay loam.	Same	Medium to strongly acid.	Well	Moderate to rapid.	Slow	Slight	Medium to high.	High.
Lyles loam, 0 to 3 percent slopes.	Nearly level to depressed areas.	Stratified sands; neutral to alkaline	Very dark grayish-brown loam.	Mottled gray and yellowish-brown loam to sandy clay loam.	Slightly acid to neutral.	Neutral to mildly alkaline.	Poor to very poor	Moderate	Very slow to ponded.	None	Medium	Medium to high.
Metea fine sandy loam, 3 to 8 percent slopes.	Undulating to gently sloping areas in till plains.	Sandy drift, 20 to 40 inches thick, over loam till.	Grayish-brown fine sandy loam.	Yellowish-brown loamy sand to sandy clay loam.	Medium to slightly acid.	Medium to strongly acid.	Well	Moderate to moderately rapid.	Medium	Slight to moderate.	Medium	Medium.

SOILS OF CARROLL COUNTY, INDIANA: SUMMARY OF IMPORTANT CHARACTERISTICS—*CONTINUED*

Soil	Topography	Parent or underlying material	Surface soil	Subsoil	Acidity		Natural soil drainage	Permeability	Surface runoff	Susceptibility to erosion	Moisture-supplying capacity	General productivity
					Surface	Subsurface						
Miami silt loam, 3 to 8 percent slopes.	Gently sloping to sloping knolls and slopes on till plains.	Highly calcareous loam till of Wisconsin age.	Grayish-brown to brown silt loam.	Brown to yellowish-brown silty clay loam to clay loam.	Same	Same	Well	Moderate	Medium	Moderate	Medium to high.	High.
Miami silt loam, 3 to 8 percent slopes, eroded.	Same	Same	Grayish-brown heavy silt loam to yellowish-brown silty clay loam.	Same	Same	Same	Well	Moderate	Medium	Moderate	Medium to high.	Medium.
Miami silt loam, 8 to 12 percent slopes, eroded.	Sloping knolls and ridges; slopes bordering streams.	Same	Same	Same	Same	Same	Well	Moderate	Medium to rapid.	High	Medium to low.	Medium.
Miami silt loam, 12 to 18 percent slopes, eroded.	Moderately steep slopes on ridges and bordering streams.	Same	Same	Same	Same	Same	Well	Moderate	Rapid	High	Low	Low.
Millsdale silty clay loam, 0 to 3 percent slopes.	Swales on rock terraces	Wisconsin glacial drift, 20 to 48 inches thick, over bedrock.	Very dark grayish-brown to black silty clay loam.	Gray, mottled with yellowish-brown, silty clay loam to silty clay.	Neutral	Neutral to mildly alkaline.	Very poor	Slow to very slow.	Very slow to ponded.	None	High	High to medium.
Milton silt loam, 0 to 5 percent slopes.	Rock terraces	Same	Brown silt loam	Yellowish-brown clay loam to silty clay loam.	Medium to slightly acid.	Medium acid.	Well	Moderate	Medium	Slight to moderate.	Medium	Medium.
Monitor silt loam, 0 to 3 percent slopes.	Nearly level to slightly depressed areas on outwash terraces.	Loamy and silty outwash, 42 to 66 inches thick, over calcareous gravel and sand.	Very dark grayish-brown silt loam.	Mottled gray and yellowish-brown clay loam.	Same	Medium acid.	Imperfect	Moderate	Very slow	Slight	High	High.
Nineveh loam, 0 to 3 percent slopes.	Nearly level outwash terraces.	Loamy outwash, 25 to 40 inches thick, over calcareous gravel and sand.	Dark-brown to very dark grayish-brown loam.	Strong-brown to dark-brown loam to gravelly clay loam.	Neutral	Neutral	Well to somewhat excessive.	Moderate to rapid.	Slow	Slight	Medium to low.	Medium to low.
Oaktown loamy fine sand, 3 to 10 percent slopes.	Rolling dunes on terraces.	Loose fine sand	Brown loamy fine sand	Brown or yellowish-brown loamy fine sand, with bands of fine sandy loam.	Medium to slightly acid.	Medium acid.	Somewhat excessive to excessive.	Very rapid	Slow	Moderate wind erosion.	Very low	Low.
Ockley loam, 0 to 3 percent slopes.	Nearly level to undulating high outwash terraces.	Loamy outwash, 42 to 70 inches thick, over calcareous gravel and sand.	Brown loam	Yellowish-brown to reddish-brown clay loam to sandy clay loam.	Same	Medium to strongly acid.	Well	Moderate to rapid.	Very slow	Slight	Medium	Medium to high.
Ockley loam, 3 to 8 percent slopes.	Gently sloping to sloping areas on high outwash terraces.	Same	Brown loam	Same	Same	Same	Well	Moderate to rapid.	Medium	Moderate	Medium	Medium to high.
Ockley loam, 3 to 8 percent slopes, eroded.	Same	Same	Grayish-brown heavy loam to yellowish-brown clay loam.	Same	Same	Same	Well	Moderate to rapid.	Medium	Moderate	Medium	Medium.
Ockley silt loam, 0 to 3 percent slopes.	Nearly level to undulating high outwash terraces.	Silty and loamy outwash, 42 to 72 inches thick, over calcareous gravel and sand.	Brown silt loam	Yellowish-brown to reddish-brown silty clay loam.	Same	Same	Well	Moderate to rapid.	Very slow	Slight	Medium to high.	High.
Ockley silt loam, 3 to 8 percent slopes.	Gently sloping to sloping areas on high outwash terraces.	Same	Brown silt loam	Same	Same	Same	Well	Moderate to rapid.	Medium	Moderate	Medium to high.	High.
Ockley silt loam, 3 to 8 percent slopes, eroded.	Same	Same	Grayish-brown heavy silt loam to yellowish-brown silty clay loam.	Same	Same	Same	Well	Moderate to rapid.	Medium	Moderate	Medium	Medium.
Rodman gravelly loam, 25 to 60 percent slopes.	Steep terrace slopes	Calcareous gravel and sand	Dark-brown to very dark grayish-brown gravelly loam.	Loose gravel and sand	Mildly alkaline to calcareous.	Calcareous	Excessive	Very rapid	Very rapid	Moderate to high.	Very low	Very low.
Ross loam, 0 to 3 percent slopes.	Natural levees, or high bottoms.	Neutral alluvium from areas of Wisconsin drift.	Very dark grayish-brown loam.	Dark-brown to yellowish-brown heavy loam.	Neutral	Neutral	Well	Moderate	Slow	None	High	High.
Ross silt loam, 0 to 3 percent slopes.	Same	Same	Very dark grayish-brown silt loam.	Dark-brown to yellowish-brown heavy silt loam.	Neutral	Neutral	Well	Moderate	Slow	None	High	High to very high.
Ross silty clay loam, 0 to 3 percent slopes.	Same	Same	Very dark brown silty clay loam.	Dark-brown to yellowish-brown silty clay loam.	Neutral	Neutral	Well	Moderate	Slow	None	High	High to very high.

SOILS OF CARROLL COUNTY, INDIANA: SUMMARY OF IMPORTANT CHARACTERISTICS—*CONTINUED*

Soil	Topography	Parent or underlying material	Surface soil	Subsoil	Acidity		Natural soil drainage	Permeability	Surface runoff	Susceptibility to erosion	Moisture-supplying capacity	General productivity
					Surface	Subsurface						
Russell silt loam, 0 to 3 percent slopes.	Nearly level to undulating areas on till plains.	18 to 36 inches of loess over loam till; calcareous till at 42 to 70 inches.	Brown to grayish-brown silt loam.	Brown to yellowish-brown silty clay loam.	Medium to slightly acid.	Medium to strongly acid.	Well	Moderate	Slow	Slight	High	High.
Russell silt loam, 3 to 8 percent slopes.	Gently sloping knolls, ridges, and upper slopes along drainageways.	Same	Same	Same	Same	Same	Well	Moderate	Medium	Moderate	Medium to high.	High.
Russell silt loam, 3 to 8 percent slopes, eroded.	Same	Same	Grayish-brown silt loam to yellowish-brown silty clay loam.	Same	Medium acid.	Same	Well	Moderate	Medium	Moderate	Medium	Medium to high.
Russell silt loam, 8 to 12 percent slopes.	Sloping areas along drainageways.	Same	Grayish-brown silt loam.	Same	Medium to slightly acid.	Same	Well	Moderate	Medium to rapid.	High	Medium	Medium.
Russell silt loam, 8 to 12 percent slopes, eroded.	Same	Same	Grayish-brown silt loam to yellowish-brown silty clay loam.	Same	Medium acid.	Same	Well	Moderate	Medium to rapid.	High	Medium to low.	Medium to low.
Russell silt loam, 12 to 25 percent slopes.	Moderately steep areas along drainageways.	Same	Grayish-brown silt loam.	Same	Medium to slightly acid.	Same	Well	Moderate	Rapid	High to very high.	Low	Low.
Russell silt loam, 12 to 25 percent slopes, eroded.	Same	Same	Grayish-brown silt loam to yellowish-gray silty clay loam.	Same	Same	Same	Well	Moderate	Rapid	High to very high.	Low	Low.
Russell silt loam and silty clay loam, 3 to 8 percent slopes, severely eroded.	Gently sloping knolls, ridges, and upper slopes along drainageways.	Same	Yellowish-brown heavy silt loam to silty clay loam.	Same	Medium acid.	Same	Well	Slow	Moderate to rapid.	Very high	Low	Low.
Russell silt loam and silty clay loam, 8 to 12 percent slopes, severely eroded.	Sloping areas on knolls and around drainageways.	Same	Same	Same	Medium acid.	Same	Well	Slow	Moderate to rapid.	Very high	Low	Low.
Russell silt loam and silty clay loam, 12 to 25 percent slopes, severely eroded.	Moderately steep areas along drainageways.	Same	Same	Same	Medium acid.	Same	Well	Slow	Rapid	High to very high.	Very low	Very low.
Sleeth silt loam, 0 to 3 percent slopes.	Nearly level to very gently sloping outwash terraces.	Silty and loamy outwash, 42 to 72 inches thick, over calcareous gravel and sand.	Grayish-brown silt loam.	Mottled gray and yellowish-brown silty clay loam to clay loam.	Medium to slightly acid.	Same	Imperfect	Slow to moderate.	Slow	Slight	High	Medium to high.
Sloan silt loam, 0 to 3 percent slopes.	Swales and old drainageways in bottoms.	Neutral to calcareous alluvium from timbered Wisconsin drift areas.	Dark-brown to very dark gray silt loam.	Same	Neutral	Neutral	Very poor	Slow to moderate.	Very slow	None	Very high	Very high.
Sloan silty clay loam, 0 to 3 percent slopes.	Same	Same	Dark-brown to very dark gray silty clay loam.	Same	Neutral	Neutral	Very poor	Slow to moderate.	Very slow	None	Very high	Very high.
Washtenaw silt loam, 0 3 percent slopes.	Depressional flats and kettle holes.	Light-colored colluvium, 10 to 40 inches thick, on dark-colored material.	Grayish-brown or brown silt loam.	Grayish-brown to dark grayish-brown silt loam to silty clay loam.	Slightly acid to neutral.	Slightly acid to neutral.	Imperfect to poor.	Moderate	Very slow to ponded.	None	High	High.
Westland loam, 0 to 3 percent slopes.	Swales and former meander channels in outwash terraces.	Loamy and silty outwash, 40 to 60 inches thick, over calcareous gravel and sand.	Very dark grayish-brown loam.	Mottled gray and yellowish-brown clay loam to silty clay loam.	Same	Same	Very poor	Slow	Very slow	None	Very high	High to very high.
Westland silt loam, 0 to 3 percent slopes.	Same	Same	Very dark grayish-brown silt loam.	Same	Same	Same	Very poor	Slow	Very slow	None	Very high	Very high.
Westland silty clay loam, 0 to 3 percent slopes.	Same	Same	Very dark grayish-brown silty clay loam.	Same	Same	Same	Very poor	Slow	Very slow	None	Very high	Very high.